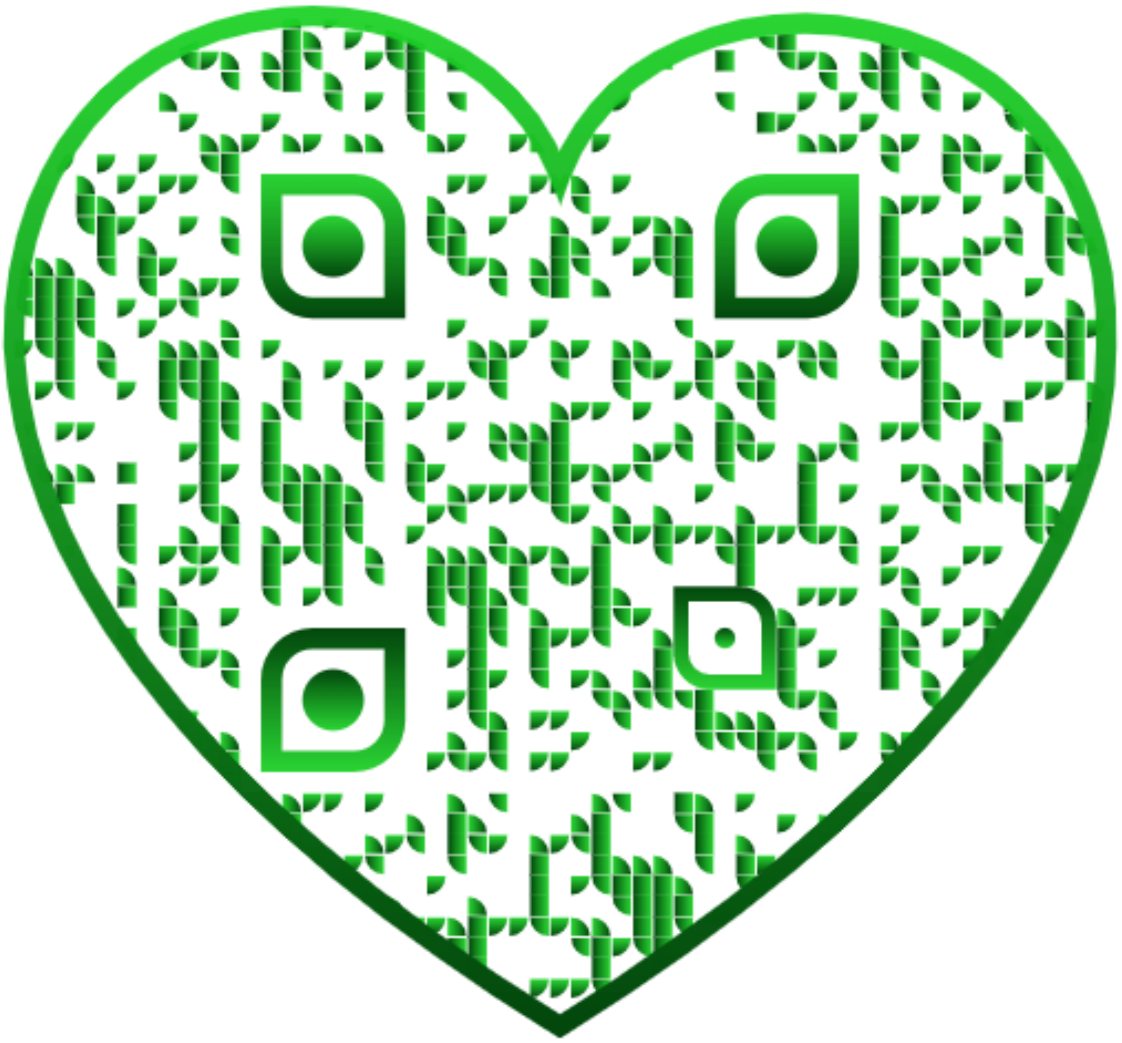
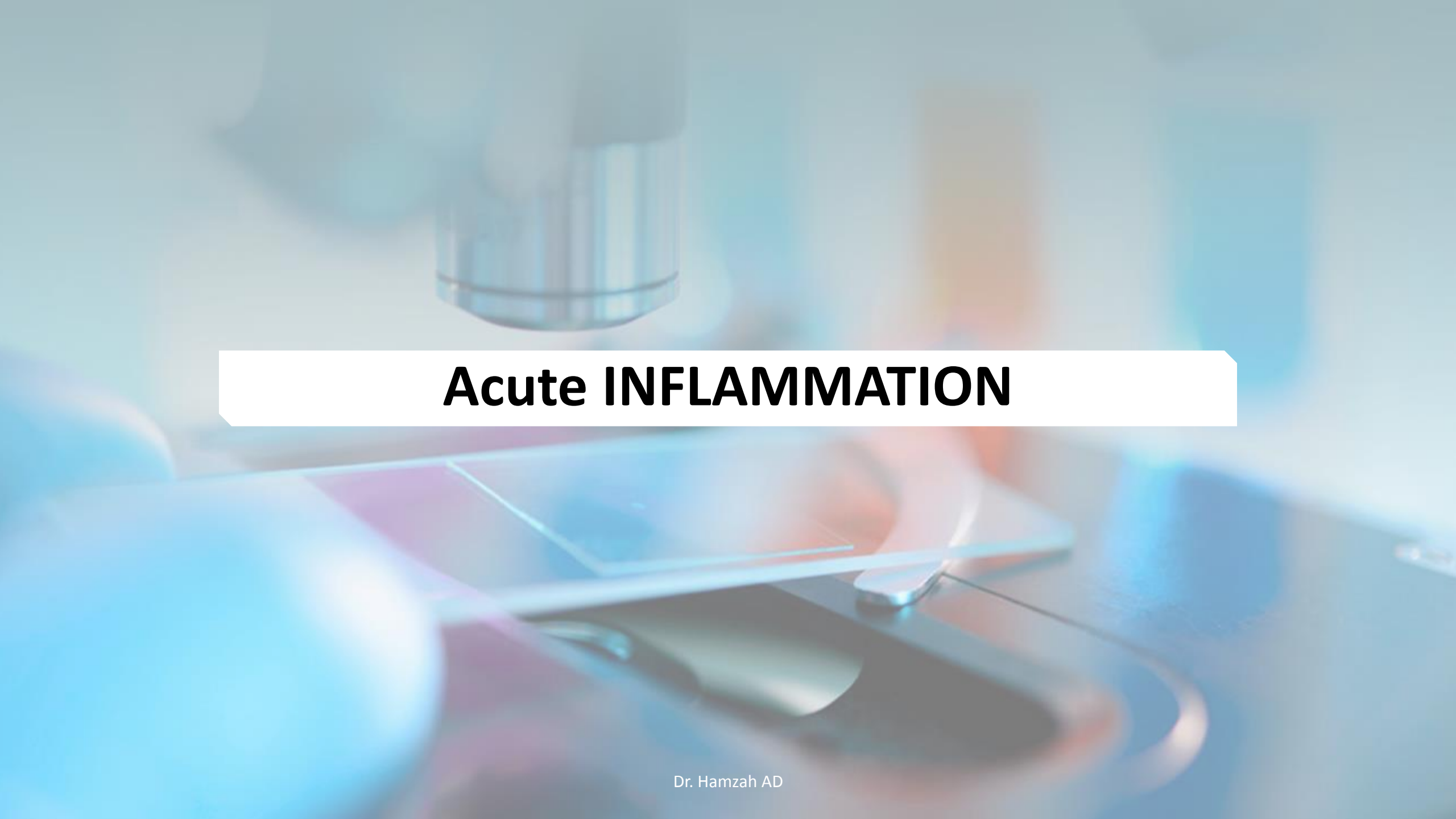
Pathology LAB 2 (Inflammation)

Dr. Hamzah AD.





Acute INFLAMMATION

Dr. Hamzah AD

GENERAL FEATURES AND CAUSES OF INFLAMMATION

• Inflammation is a beneficial host response to foreign invaders and Dead tissue, but also may cause tissue damage.

• The main components of inflammation are: a vascular reaction and a cellular response; both are activated by mediators that are derived from plasma proteins and various cells.

• **The steps of the inflammatory response** can be remembered as the **five Rs**:

(1) recognition of the injurious agent, (2) recruitment of leukocytes, (3) removal of the agent, (4) regulation (control) of the response, and (5) resolution (repair).

• **The causes of inflammation include:**

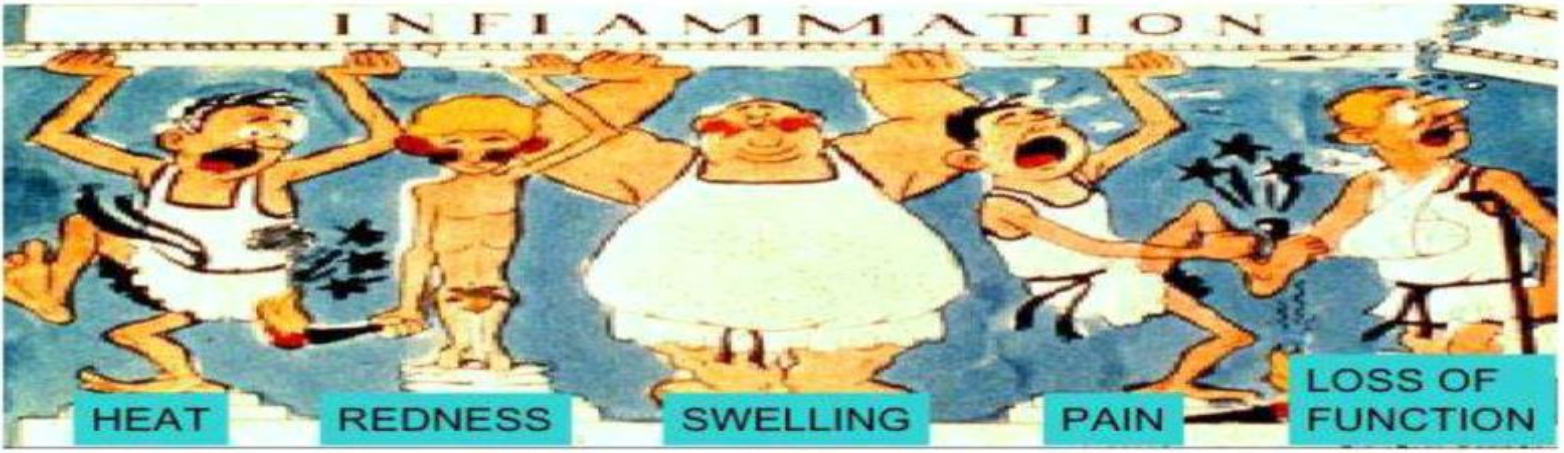
Infections, tissue necrosis, foreign bodies, trauma, and immune responses.

• Epithelial cells, tissue macrophages and dendritic cells, leukocytes, and other cell types **express receptors that sense the presence of microbes and necrotic cells.**

• **The outcome of acute inflammation:** is either **elimination of the noxious stimulus** followed by decline of the reaction and repair of the damaged tissue, **or persistent injury** resulting in **chronic inflammation**.

SIGNS AND SYMPTOMS OF INFLAMMATION

- The inflammatory response can be either acute or chronic, but the local reactions are described as the cardinal signs and symptoms of inflammation:



Calor	Rubor	Tumor	Dolor	Functio laesa

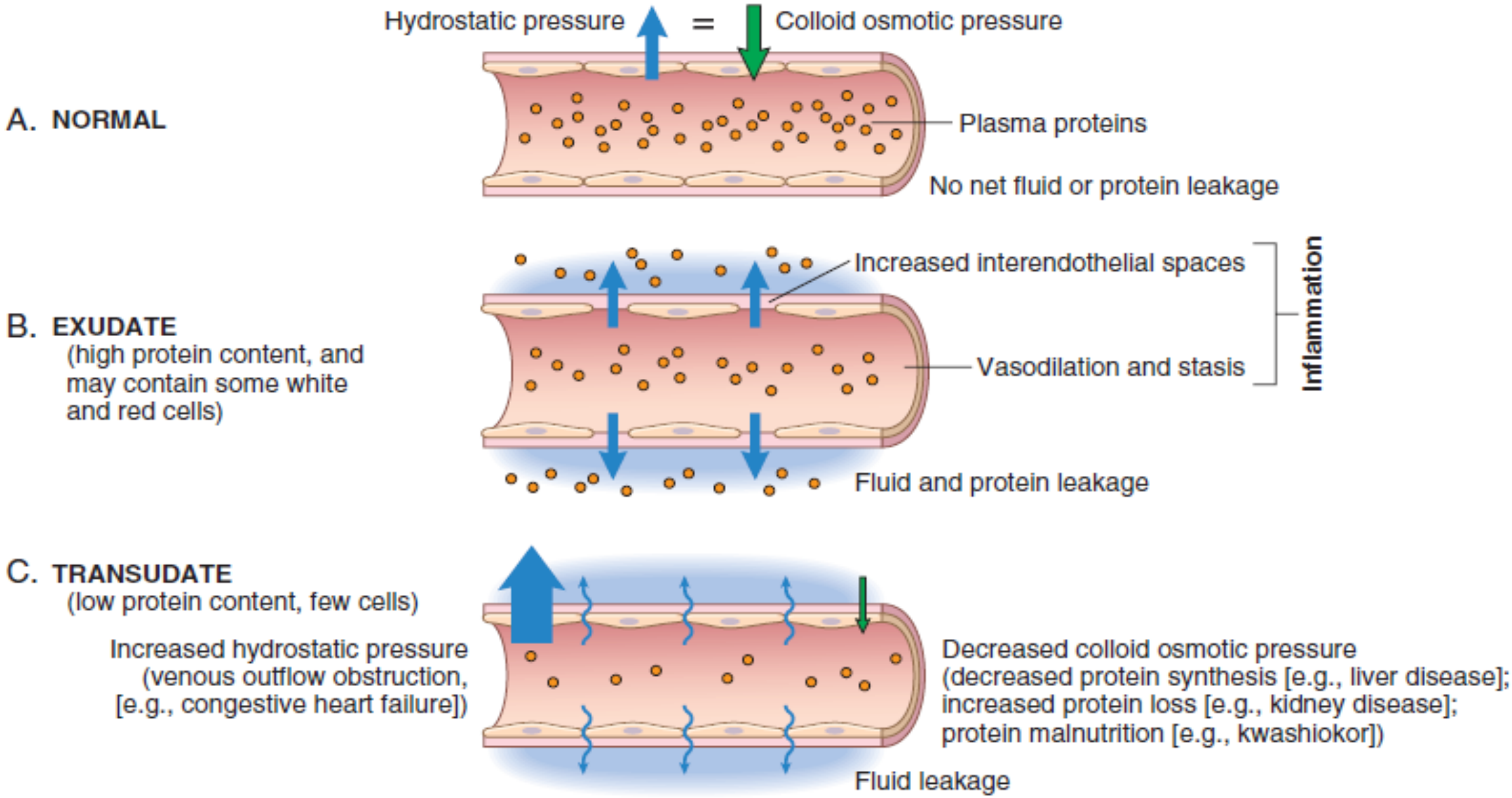
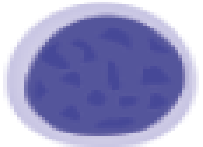
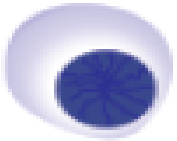
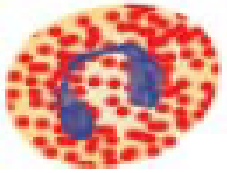

Hydrostatic pressure
=
Colloid osmotic pressure
A. NORMAL
Plasma proteins
No net fluid or protein leakage
B. EXUDATE
(high protein content, and may contain some white and red cells)
Increased interendothelial spaces
Vasodilation and stasis
Inflammation
Fluid and protein leakage
C. TRANSUDATE
(low protein content, few cells)
Increased hydrostatic pressure
(venous outflow obstruction, [e.g., congestive heart failure])
Decreased colloid osmotic pressure
(decreased protein synthesis [e.g., liver disease]; increased protein loss [e.g., kidney disease]; protein malnutrition [e.g., kwashiokor])
Fluid leakage

Table 3.1 Features of Acute and Chronic Inflammation

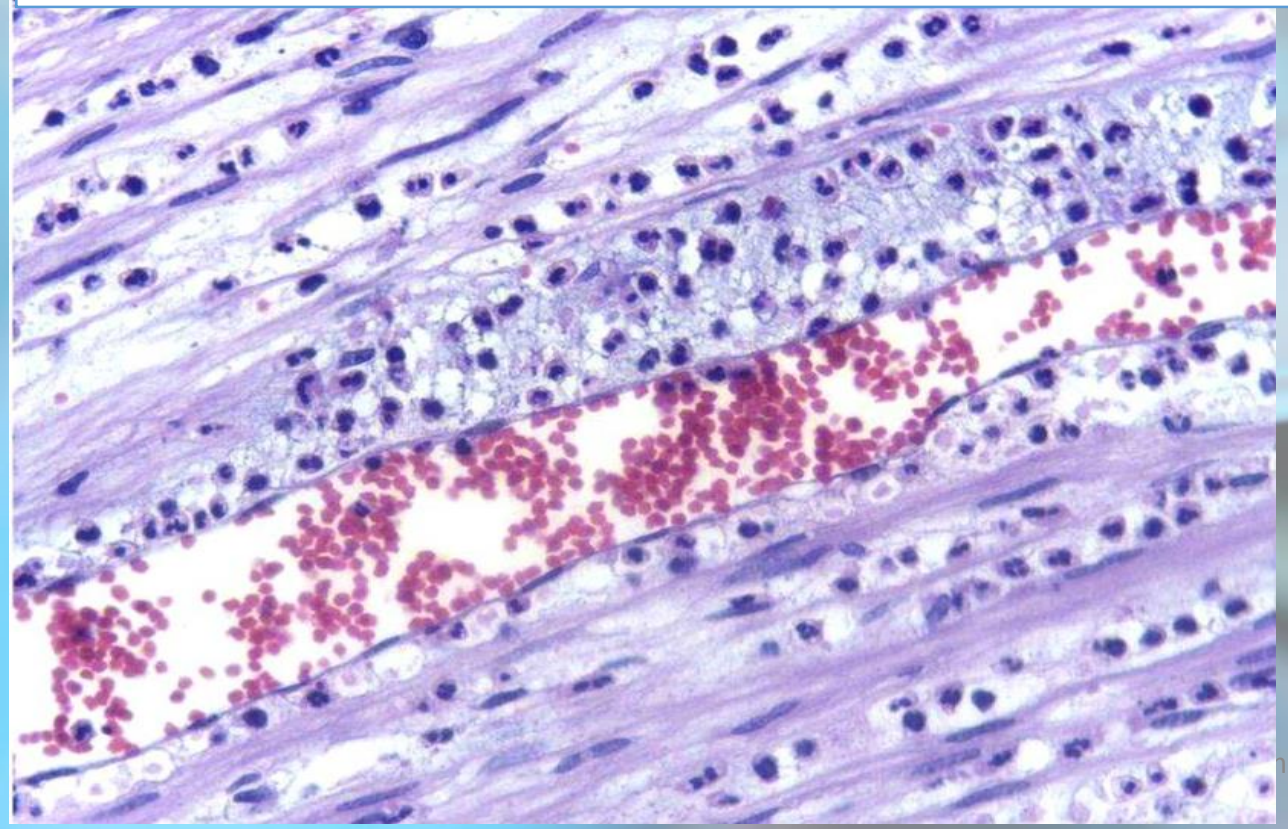
Feature	Acute	Chronic
Onset	Fast: minutes or hours	Slow: days
Cellular infiltrate	Mainly neutrophils	Monocytes/macrophages and lymphocytes
Tissue injury, fibrosis	Usually mild and self-limited	May be severe and progressive
Local and systemic signs	Prominent	Less

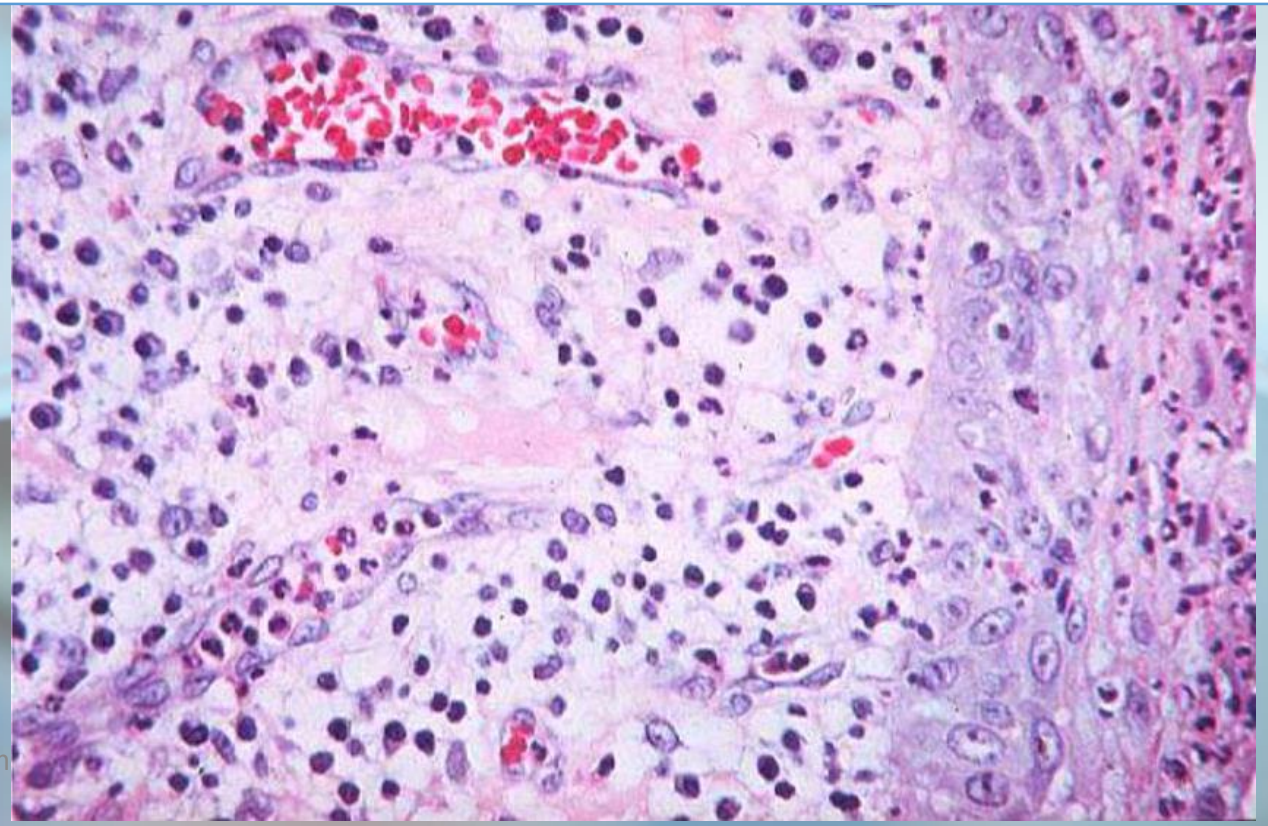
Morphology	Features
A, POLYMORPH	i. Initial phagocytosis of bacteria and foreign body ii. Acute inflammatory cell
B, MONOCYTE/MACROPHAGE	i. Bacterial phagocytosis ii. Chronic inflammatory cell iii. Regulates lymphocyte response
 C, LYMPHOCYTE	i. Humoral and cell-mediated immune responses ii. Chronic inflammatory cell iii. Regulates macrophage response
 D, PLASMA CELL	i. Derived from B cells ii. Chronic inflammatory cell
 E, EOSINOPHIL	i. Allergic states ii. Parasitic infestations iii. Chronic inflammatory cell
F, BASOPHIL/MAST CELL	i. Receptor for IgE molecules ii. Electron-dense granules

VASCULAR REACTIONS IN ACUTE INFLAMMATION

The series of events in the process of inflammation are:

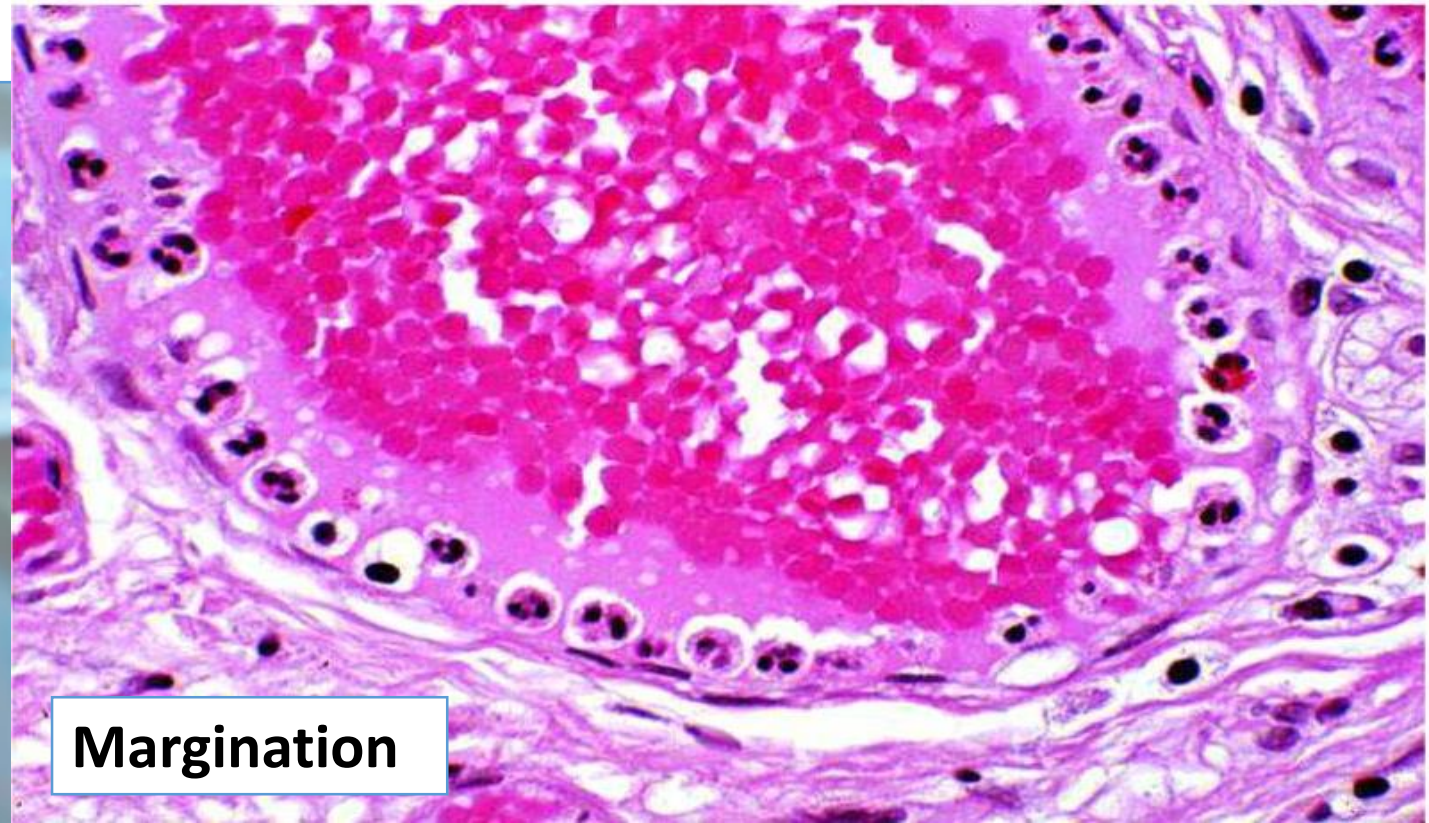
1. Vasodilation: greater blood flow to the area of inflammation, resulting in redness and heat.
2. Vascular permeability: endothelial cells become "leaky“.
3. Exudation: fluid, proteins, red blood cells, and white blood cells escape from the intravascular space.
4. Vascular stasis: slowing of the blood.





leukocytes in inflammation

- Leukocytes are recruited from the blood into the extravascular tissue, migrate to the site of infection or tissue injury, and are activated to perform their functions.
- Neutrophils predominate in the early inflammatory infiltrate and are later replaced by monocytes and macrophages.
- Leukocytes can eliminate microbes and dead cells by phagocytosis, followed by their destruction in phagolysosomes.

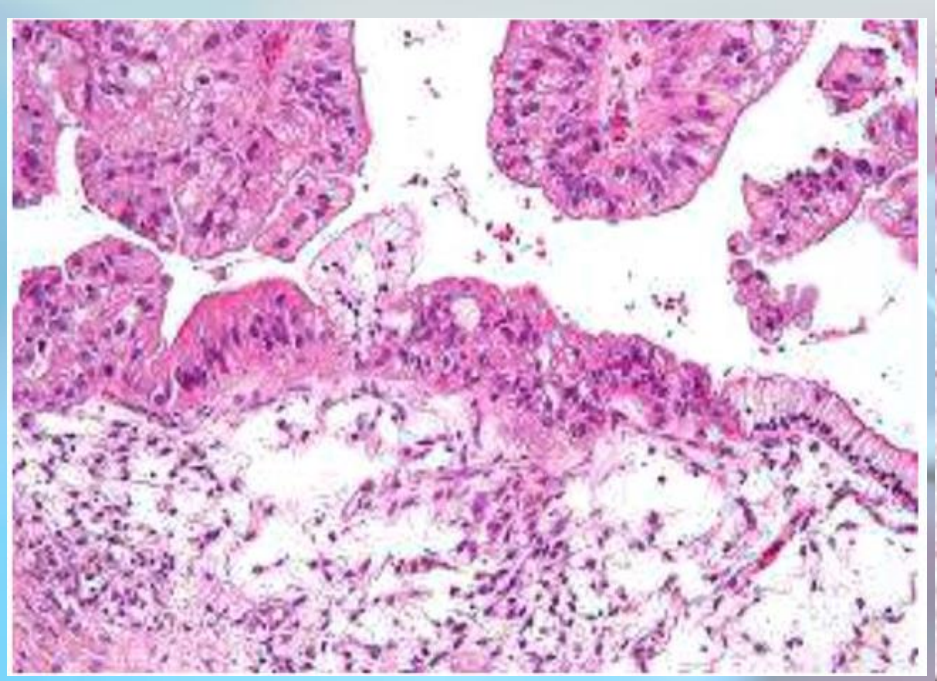


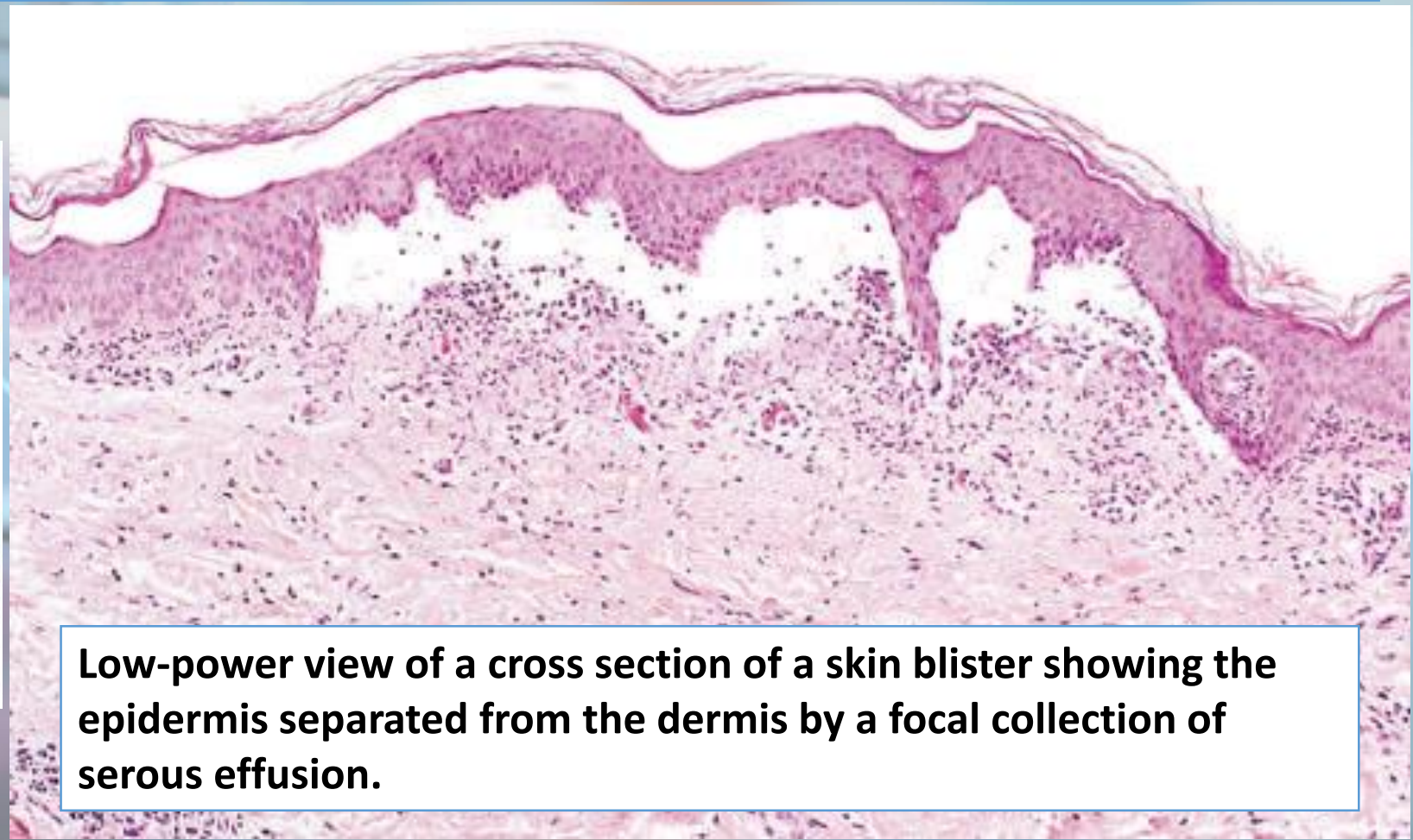
Margination

1. Serous Acute Inflammation

Serous inflammation is marked by the exudation of cell-poor fluid into spaces created by injury to surface epithelia or into body cavities lined by the peritoneum, pleura, or pericardium.

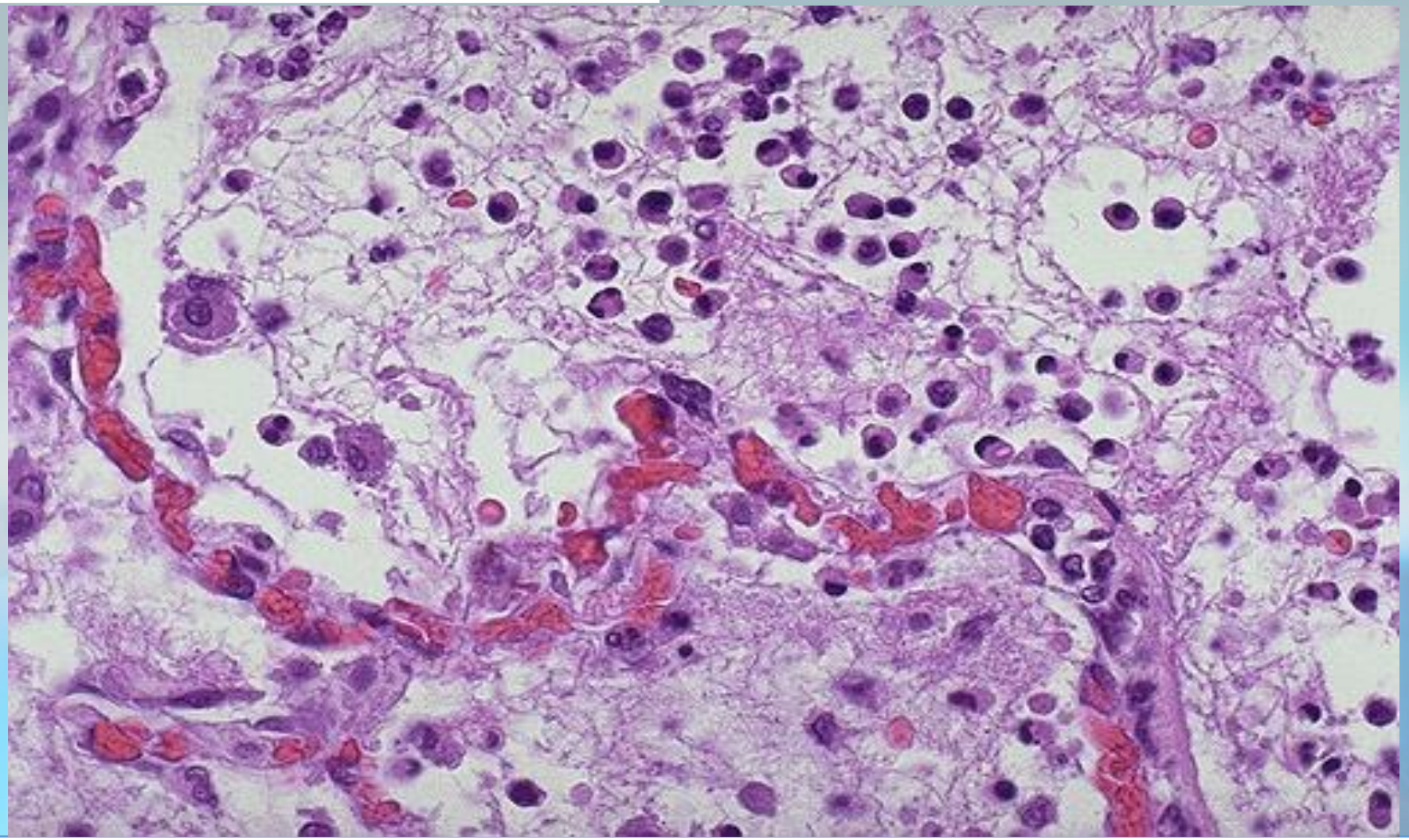
Example: The skin blister resulting from a burn or viral infection represents accumulation of serous fluid within or immediately beneath the damaged epidermis of the skin.





Low-power view of a cross section of a skin blister showing the epidermis separated from the dermis by a focal collection of serous effusion.

1. Serous Acute Inflammation

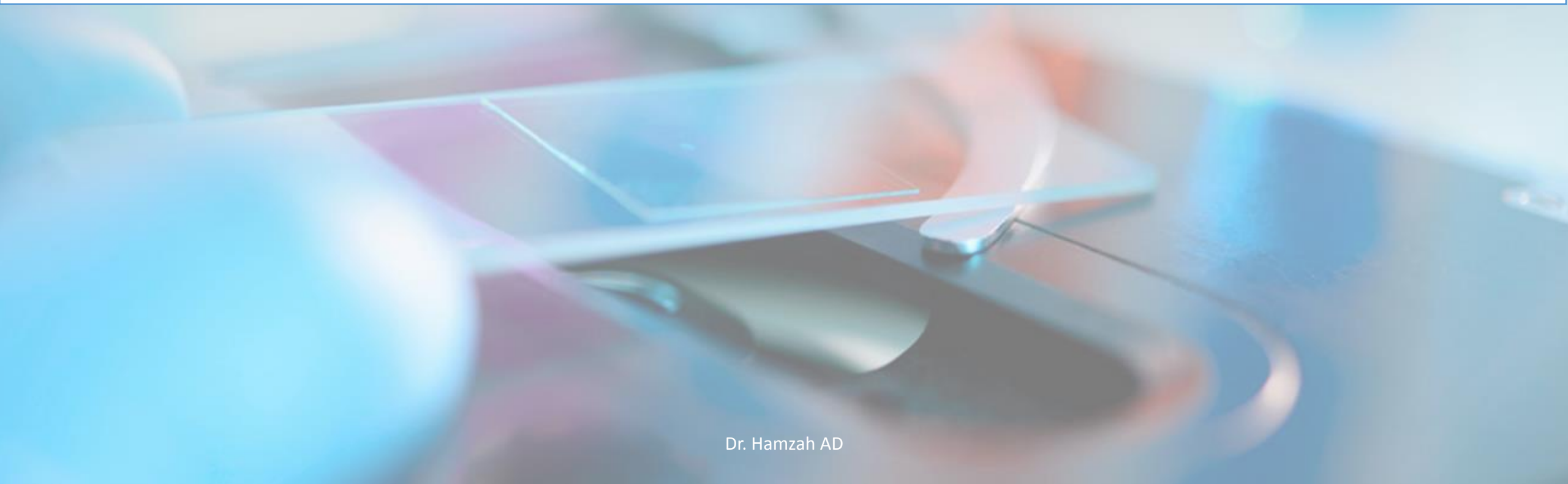


Seen here is vasodilation with exudation that has led to an outpouring of fluid into the alveolar spaces, along with PMN's.

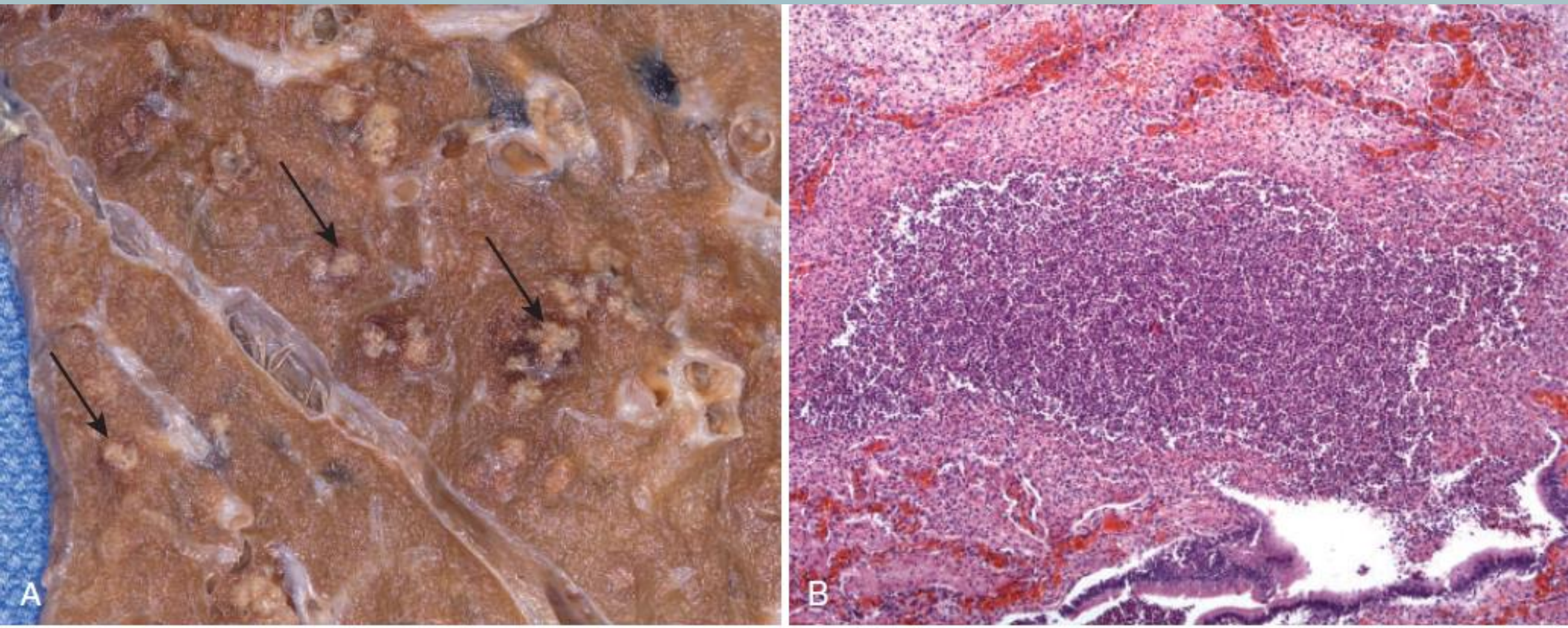
2. Purulent (Suppurative) Acute Inflammation:

Purulent inflammation is characterized by the production of pus, an exudate consisting of neutrophils, the liquefied debris of necrotic cells, and edema fluid.

Abscesses have a central region that appears as a mass of necrotic leukocytes and tissue cells. There is usually a zone of preserved neutrophils around this necrotic focus, and outside this region there may be vascular dilation and parenchymal and fibroblastic proliferation, **indicating chronic inflammation and repair**.

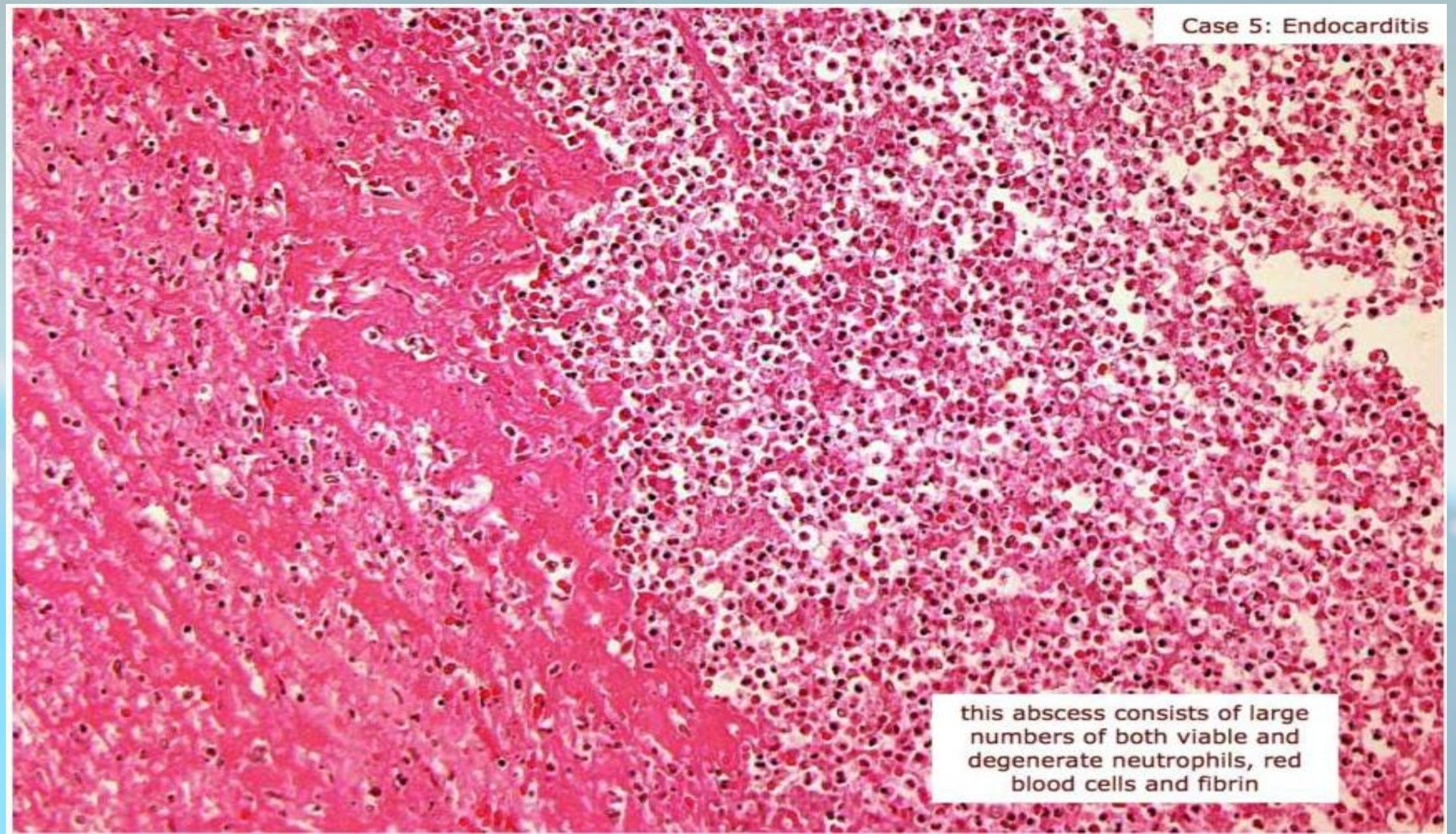


2. Purulent (Suppurative) Acute Inflammation:



(A) Multiple bacterial abscesses *(arrows)* in the lung in a case of bronchopneumonia.
(B) The abscess contains neutrophils and cellular debris, and is surrounded by congested blood vessels.

2. Purulent (Suppurative) Acute Inflammation:


Case 5: Endocarditis
this abscess consists of large numbers of both viable and degenerate neutrophils, red blood cells and fibrin

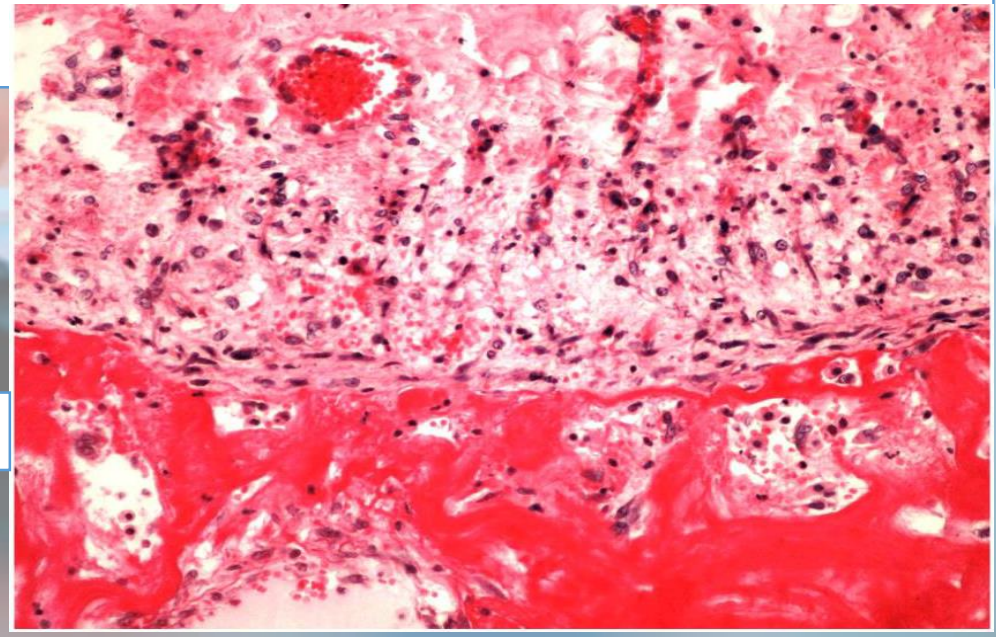
3. Fibrinous Acute Inflammation

A fibrinous exudate develops when the vascular leaks are large or there is a local procoagulant stimulus. Higher-molecular weight proteins such as **fibrinogen** pass out of the blood, and **fibrin is formed** and deposited in the extracellular space.

A fibrinous exudate is **characteristic** of inflammation in the lining of body cavities, such as the meninges, pericardium, and pleura.

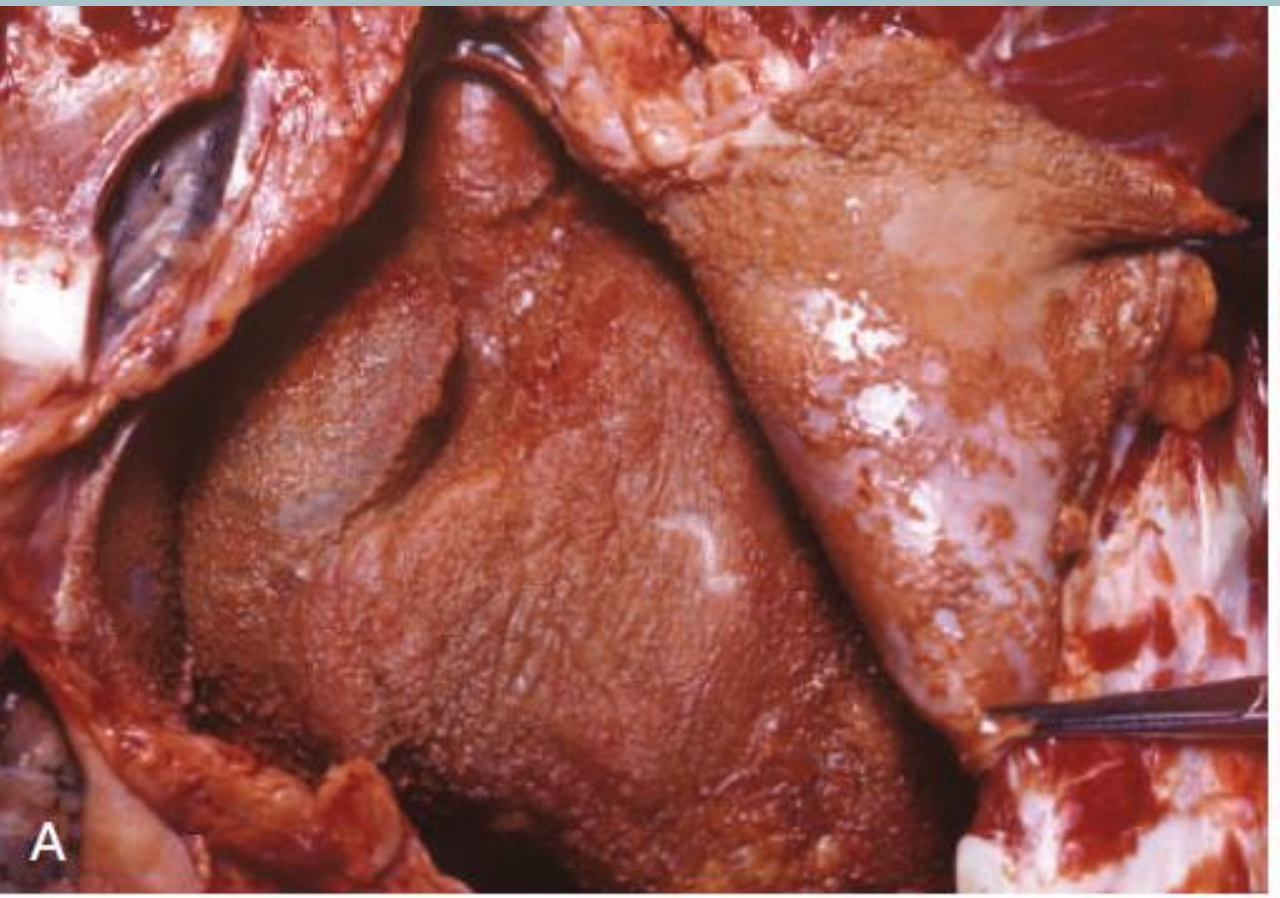
Histologically, fibrin appears as an **eosinophilic meshwork of threads.**

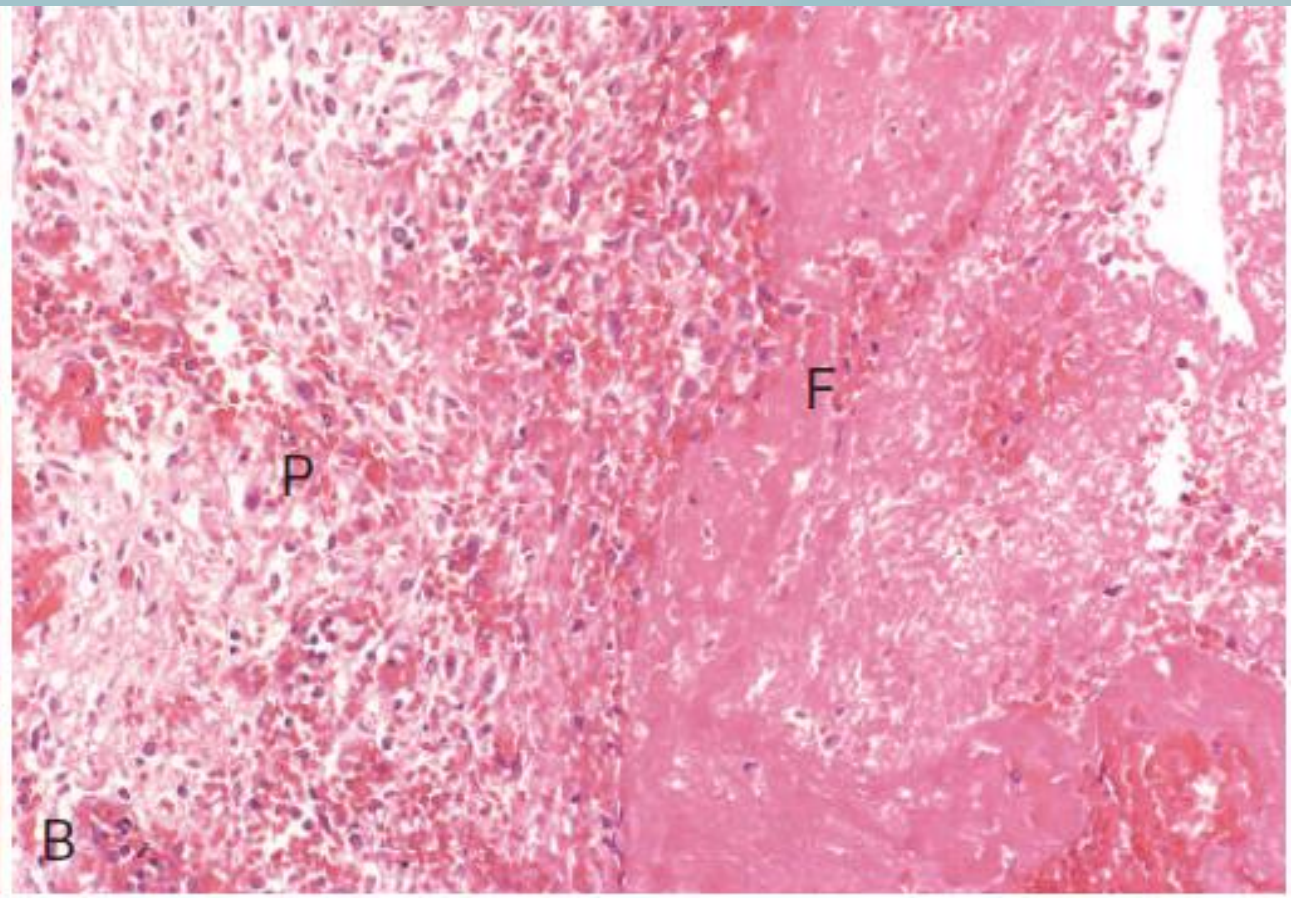
Fibrinous exudates may be dissolved by fibrinolysis and cleared by macrophages. If the fibrin is not removed, with time, it may stimulate the ingrowth of fibroblasts and blood vessels and thus **lead to scarring.**



pink meshwork of fibrin exudate

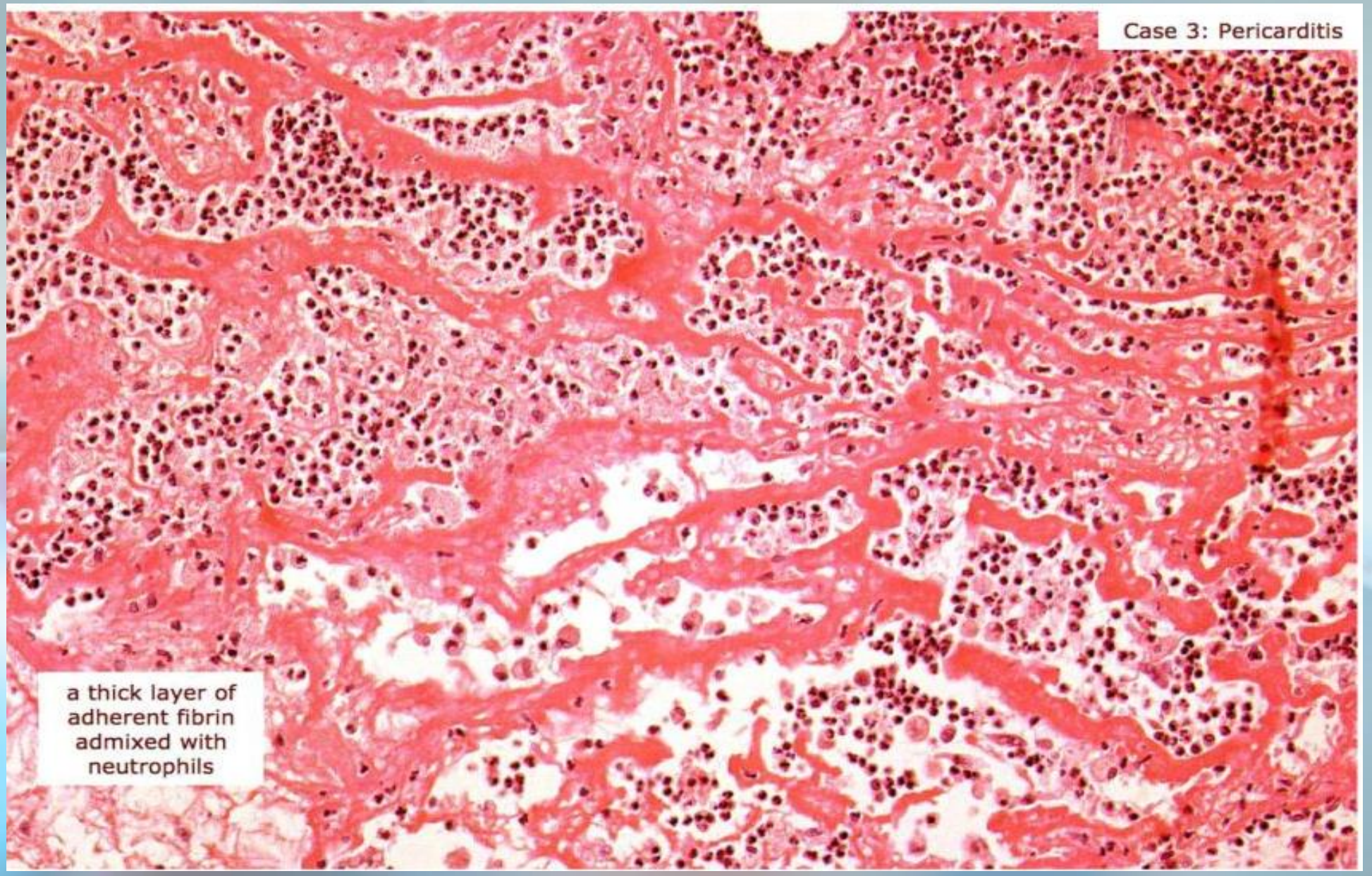
3. Fibrinous Acute Inflammation





Fibrinous pericarditis. (A) Deposits of fibrin on the pericardium.
(B) A pink meshwork of fibrin exudate *(F)* overlies the pericardial surface *(P)*.

4. Fibrino-suppurative Acute Inflammation



5. Ulcers

An ulcer is a local defect, or excavation, of the surface of an organ or tissue that is produced by the sloughing (shedding) of inflamed necrotic tissue.

It is most commonly encountered in:

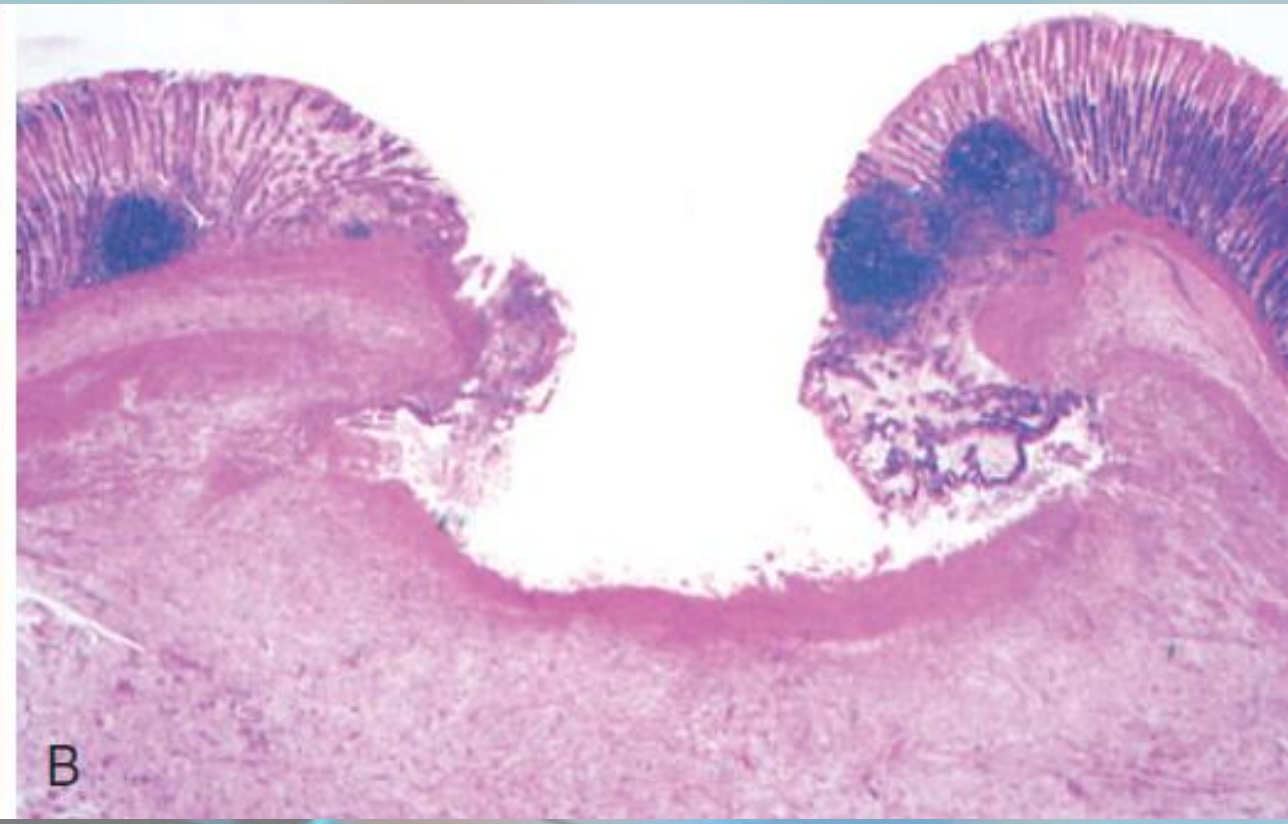
(1) the mucosa of the mouth, stomach, intestines, or genitourinary tract,

(2) the skin and subcutaneous tissue of the lower extremities in older persons who have circulatory disturbances that predispose to extensive ischemic necrosis.

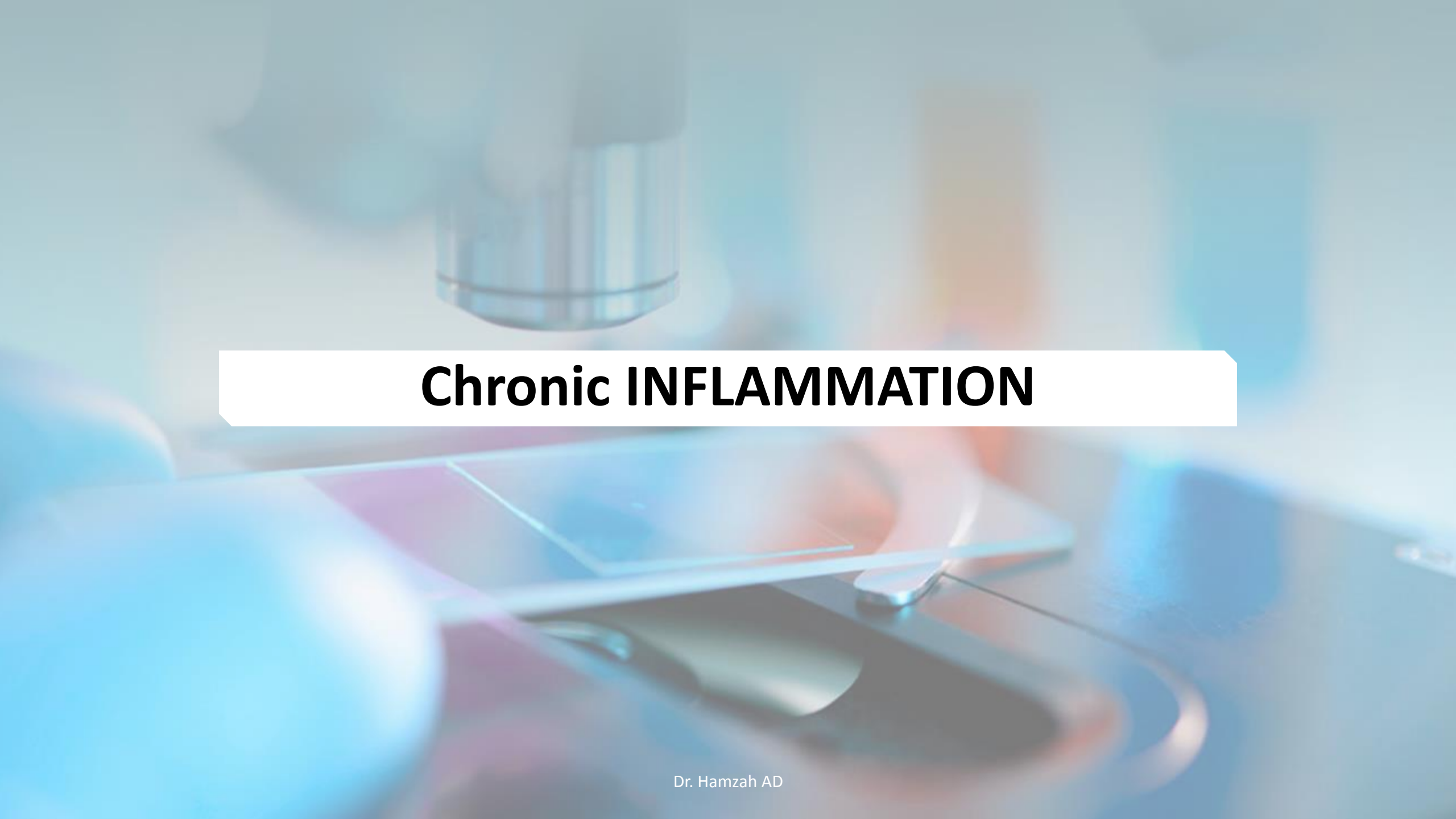
(Acute and chronic inflammation often coexist in ulcers, such as peptic ulcers of the stomach or duodenum and diabetic ulcers of the legs).

During the acute stage there is intense Polymorphonuclear infiltration and vascular dilation in the margins of the defect. With chronicity, the margins and base of the ulcer develop fibroblast proliferation, scarring, and the accumulation of lymphocytes, macrophages, and plasma cells.

5. Ulcers



The morphology of an ulcer. (A) A chronic duodenal ulcer. (B) Low-power cross-section view of a duodenal ulcer crater with an acute inflammatory exudate in the base.



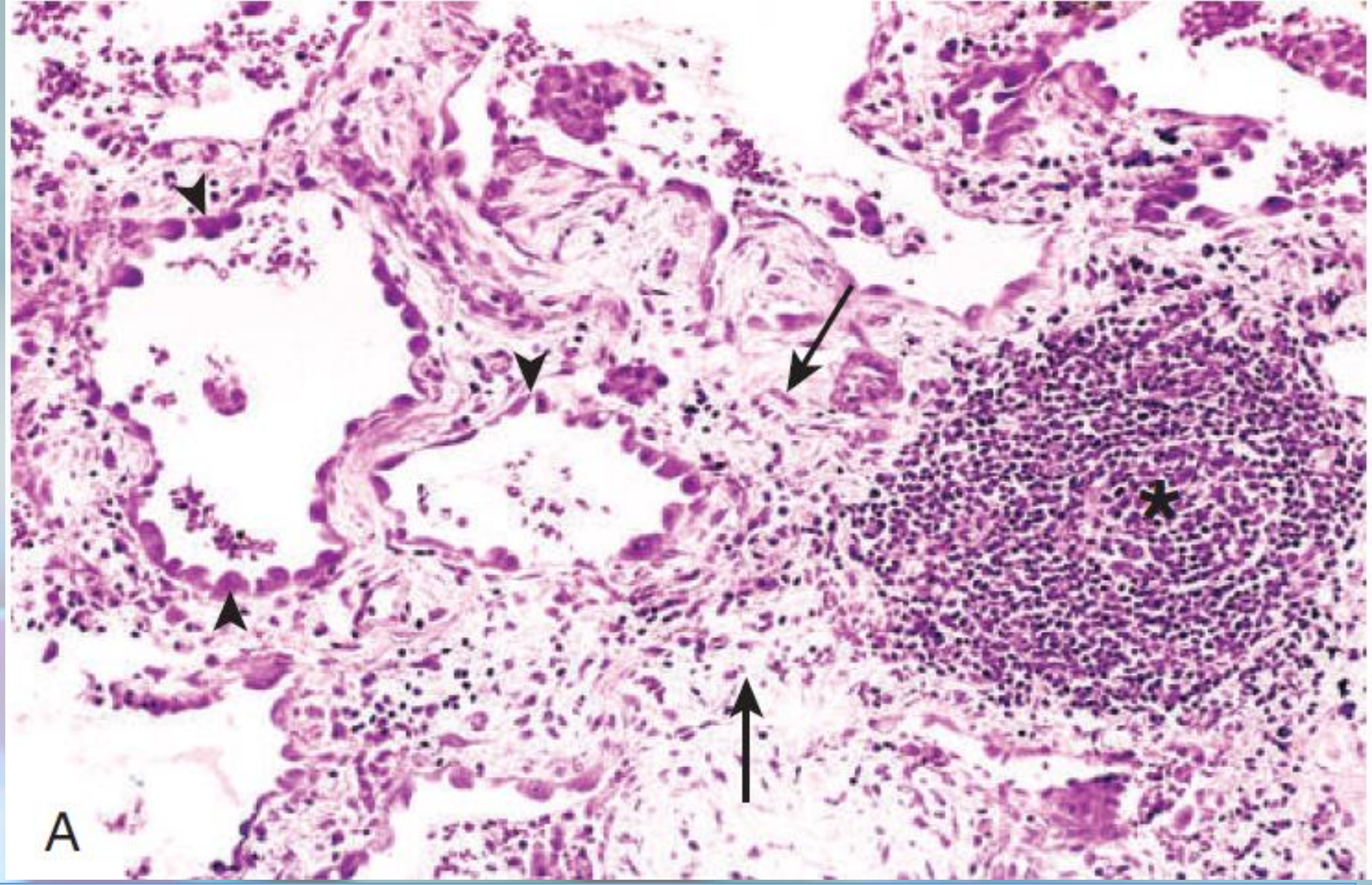
Chronic INFLAMMATION

Dr. Hamzah AD

Chronic Inflammation

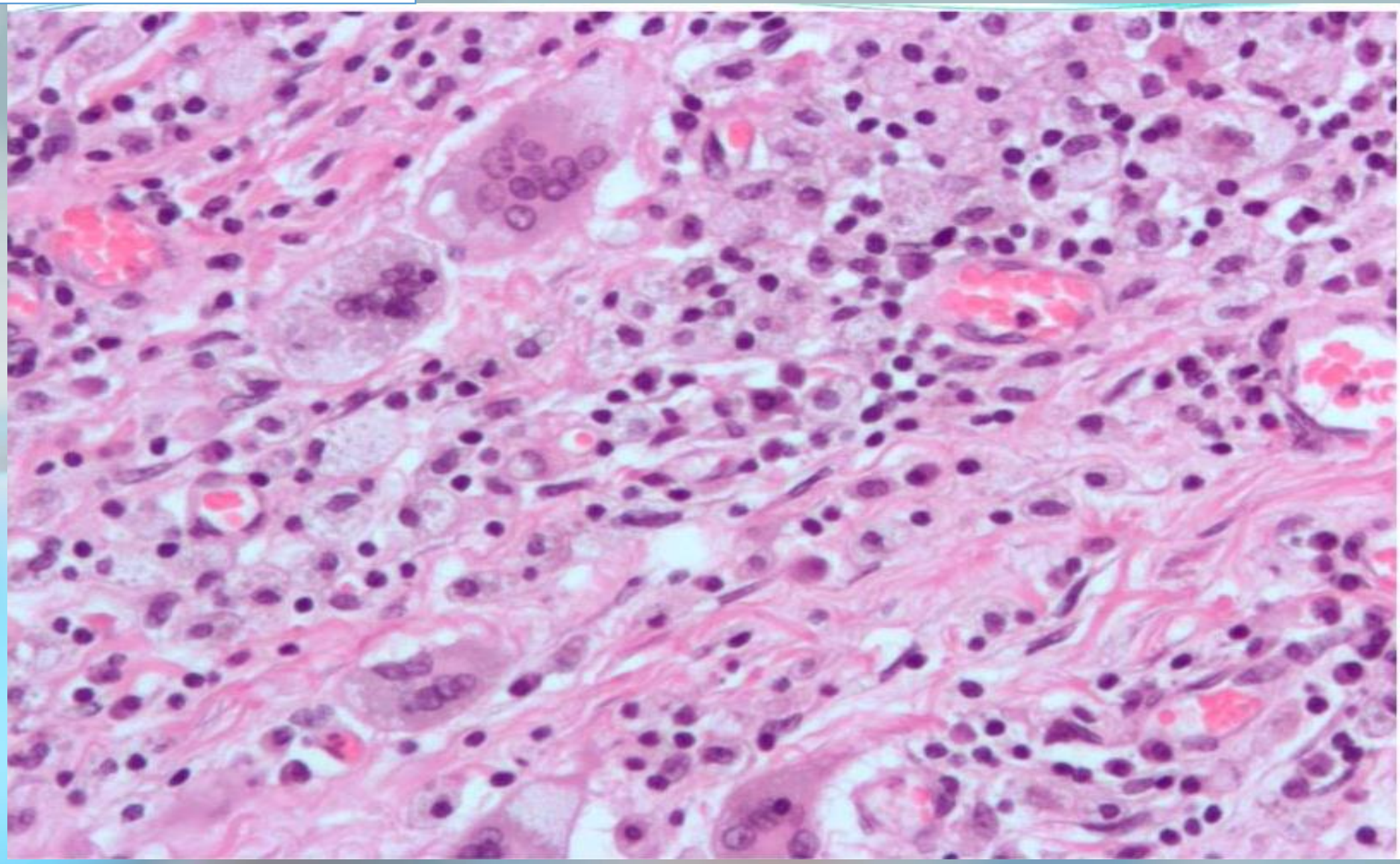
- **Chronic inflammation:** is a prolonged host response to persistent stimuli that may follow unresolved acute inflammation.
- It is caused by microbes that resist elimination, immune responses against self and environmental antigens, and some toxic substances (e.g., silica).
- **It is characterized by: coexisting inflammation, tissue injury, attempted repair by Angiogenesis (Proliferation of small blood vessels) or scarring.**
- **The cellular infiltrate consists of macrophages, lymphocytes, plasma cells, and other leukocytes.**
- **Granulomatous inflammation is a morphologically specific pattern of chronic inflammation induced by T cell and macrophage activation in response to an agent that is resistant to eradication.**

Chronic non-specific Inflammation

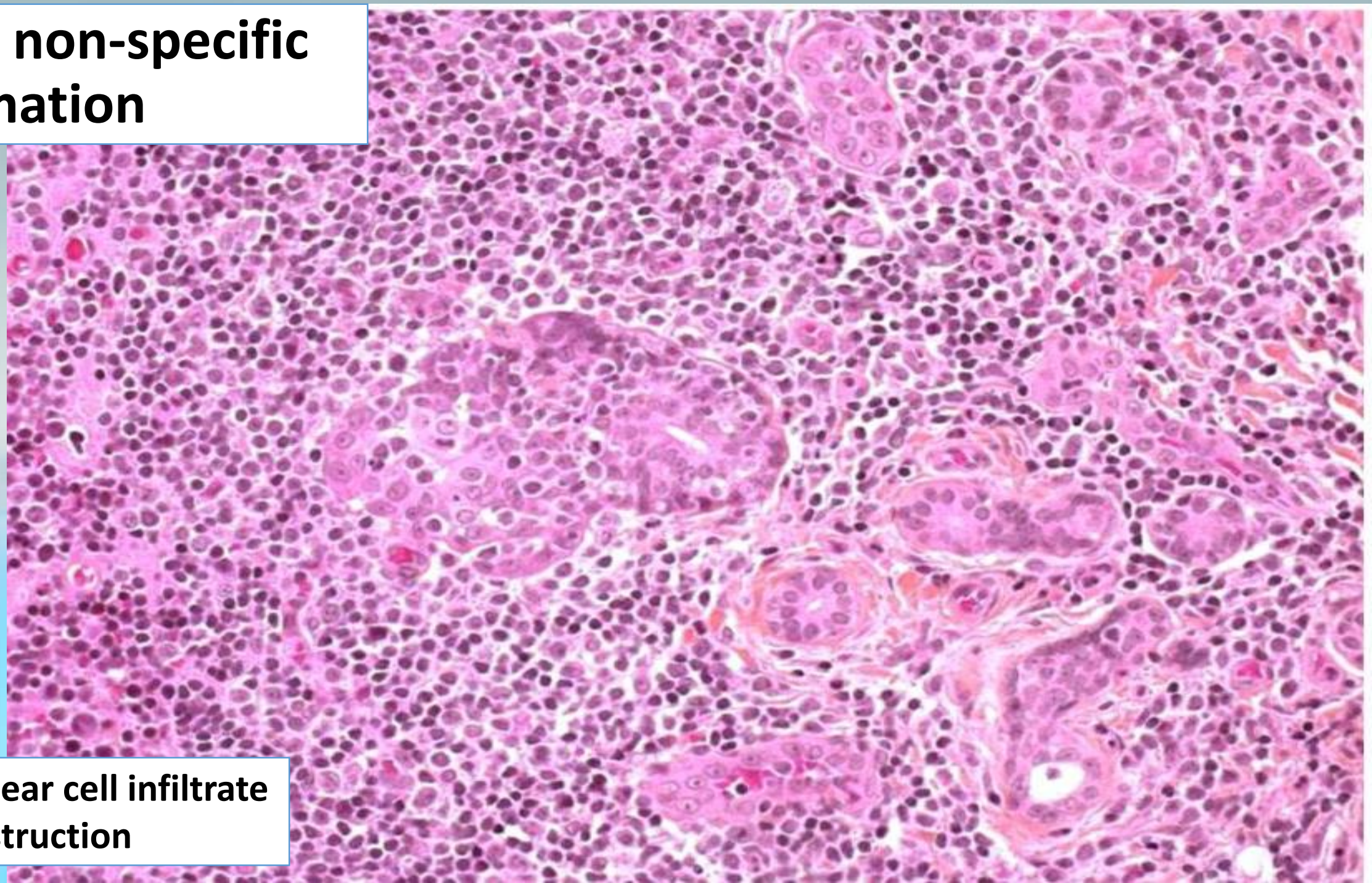


(A) Chronic inflammation in the lung, showing all three characteristic histologic features:
(1) collection of chronic inflammatory cells *(*)*,
(2) destruction of parenchyma (normal alveoli replaced by spaces lined by cuboidal epithelium, *arrowheads*),
(3) replacement by connective tissue (fibrosis, *arrows*).

Chronic non-specific inflammation



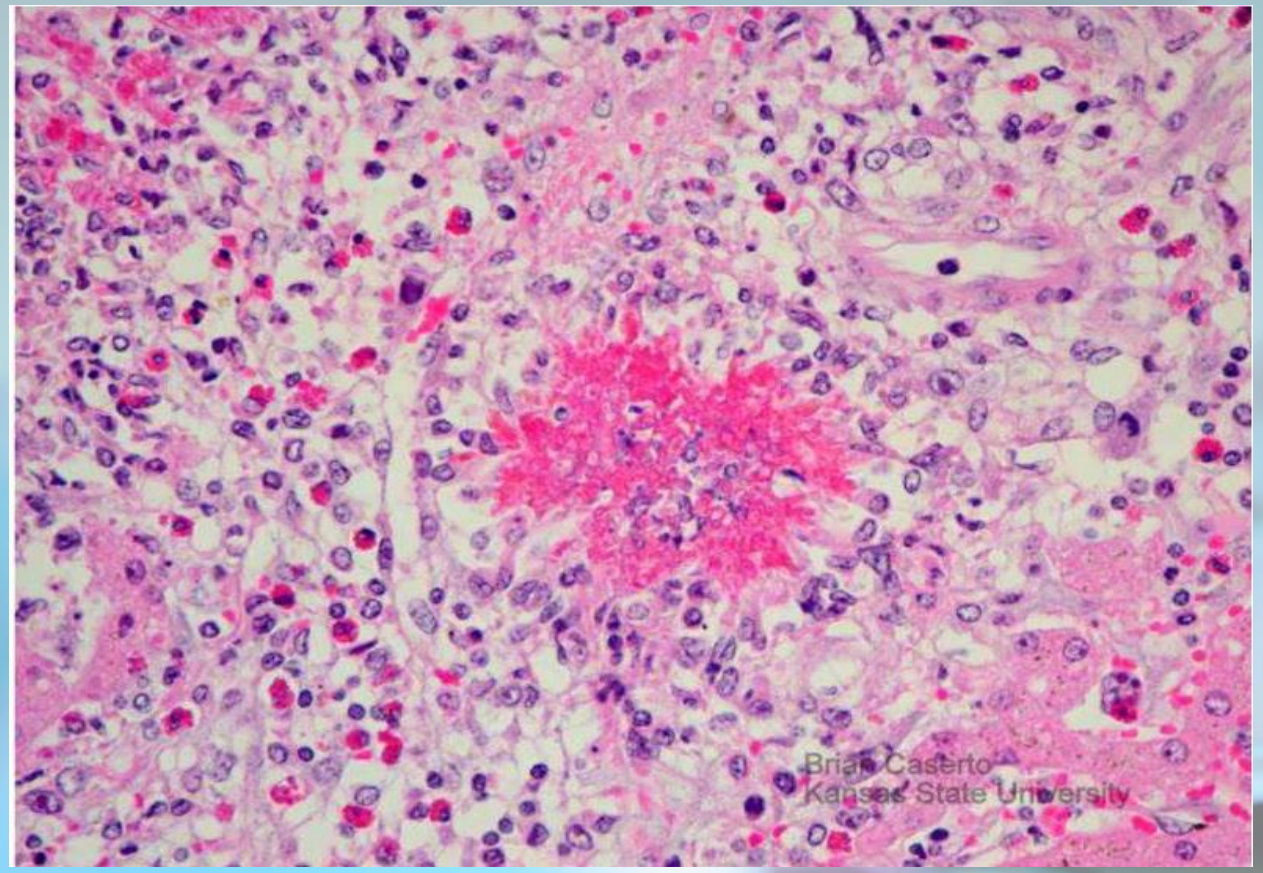
Chronic non-specific Inflammation

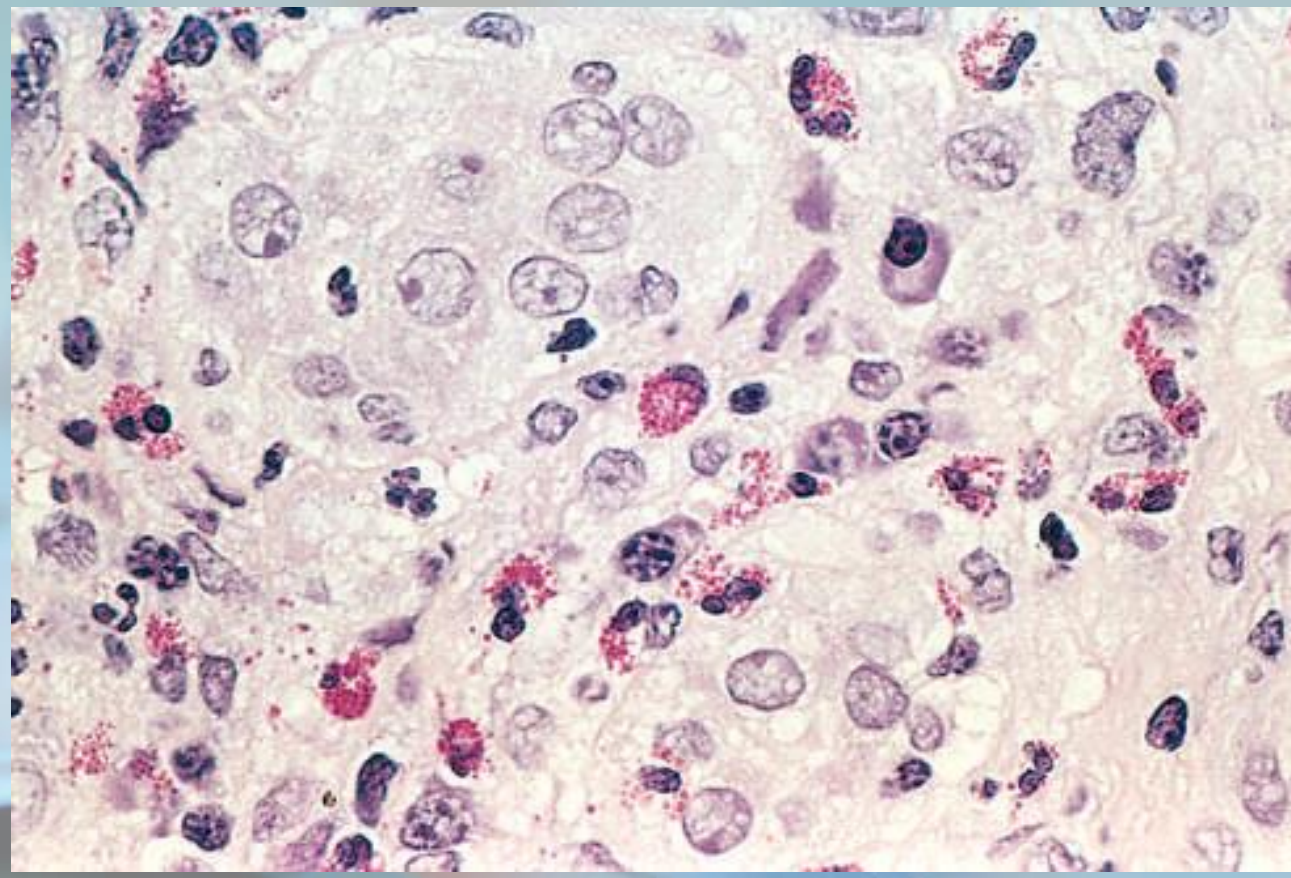


- Mononuclear cell infiltrate
- Tissue destruction

Chronic Specific inflammation

Eosinophils are abundant in immune reactions mediated by IgE and in parasitic and allergic infections.



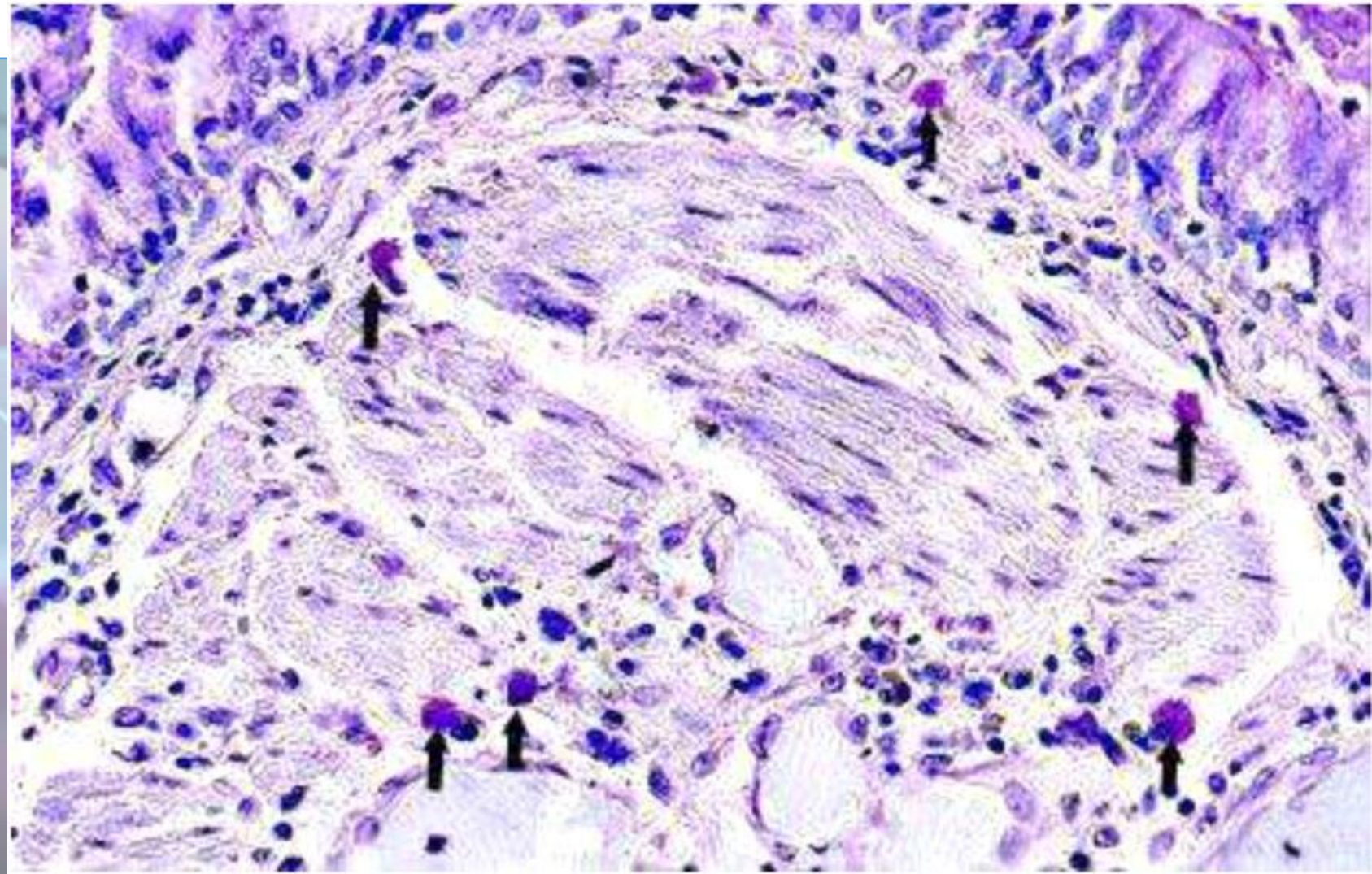


A focus of inflammation containing numerous eosinophils.

Chronic Specific inflammation

Mast cells/Basophils: are widely distributed in connective tissues and participate in both acute and chronic inflammatory reactions.

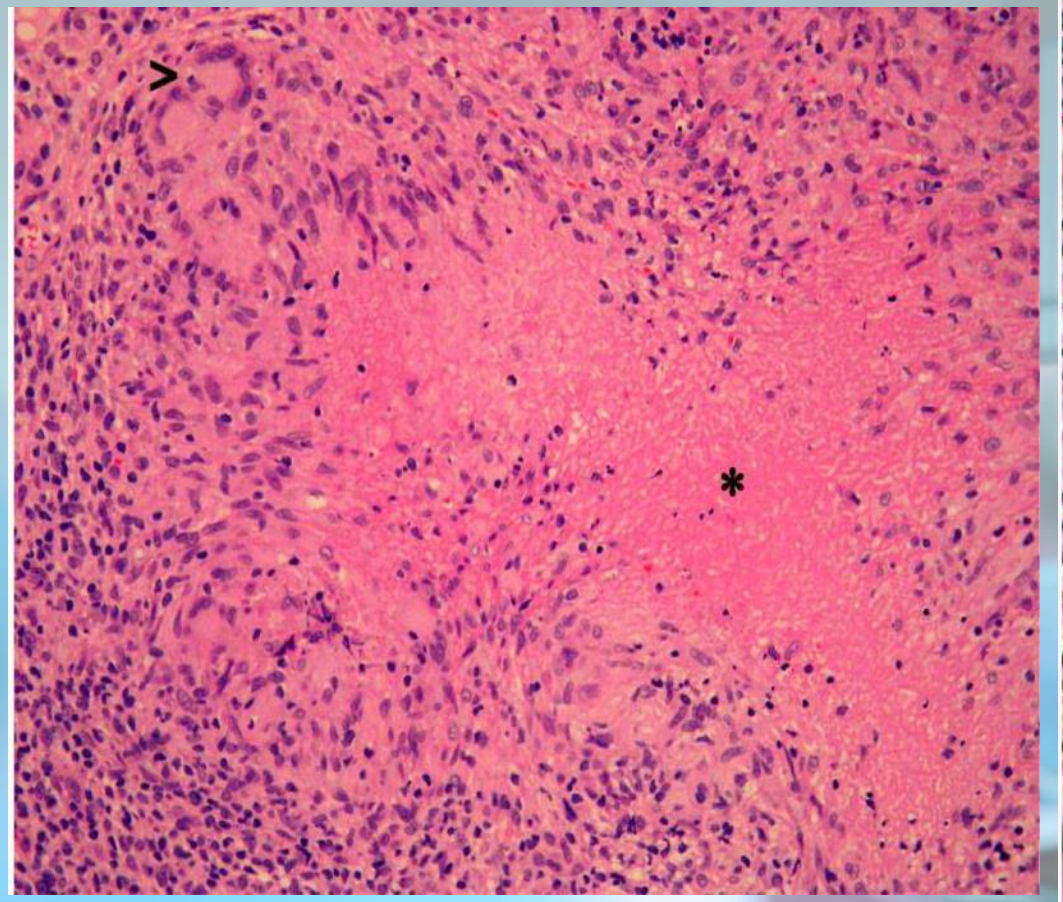
They play a role during allergic reactions to foods, insect venom, or drugs, sometimes with catastrophic results (e.g., anaphylactic shock).

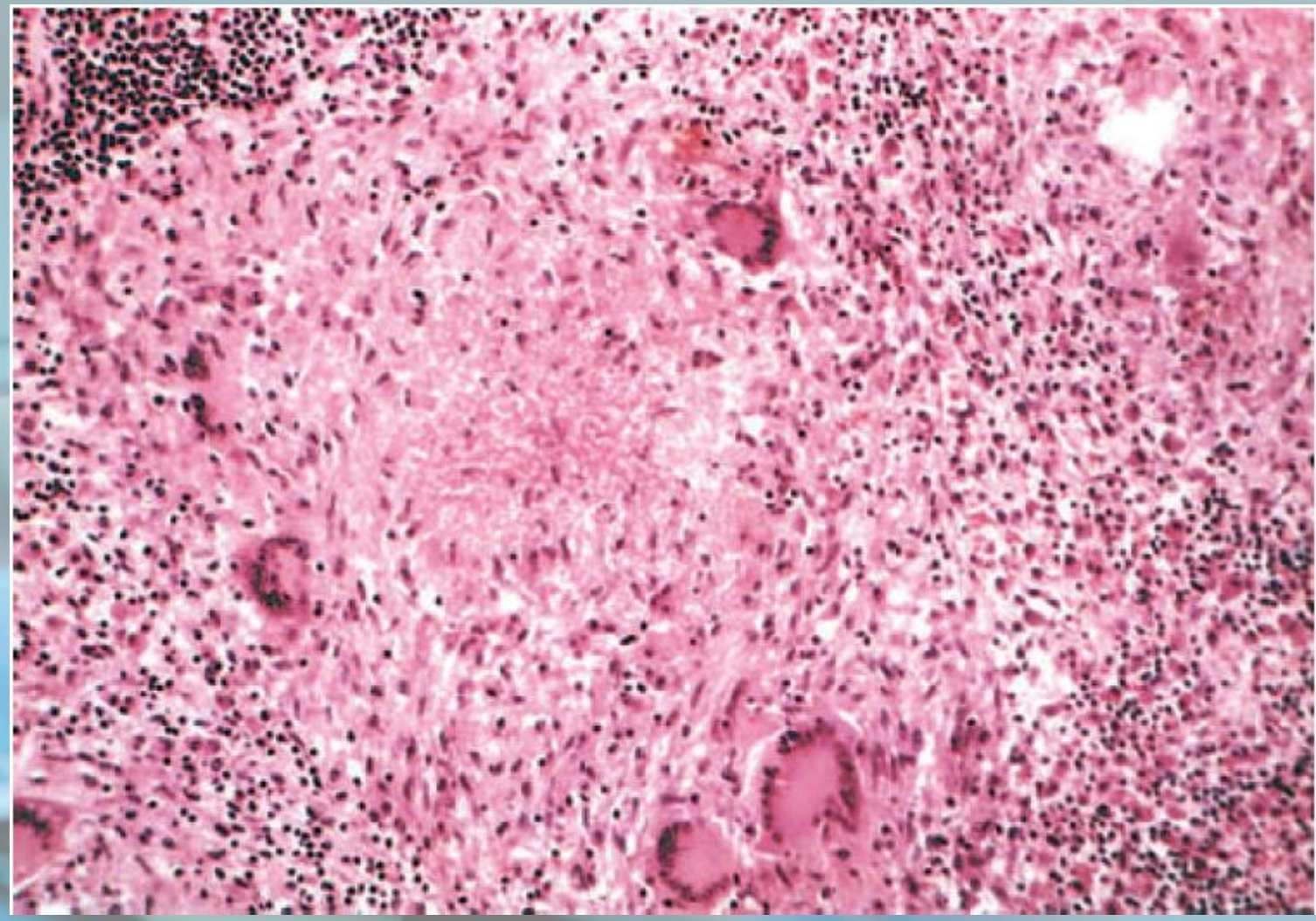


Chronic Specific inflammation: Granulomatous inflammation

- The activated macrophages in granulomas have pink granular cytoplasm with indistinct cell boundaries and are called **epithelioid cells.**
- A collar of **lymphocytes** surrounds the aggregates of epithelioid macrophages.
- Older granulomas may have a **rim of fibroblasts** and connective tissue.
- Frequently, multinucleated **giant cells** are found in granulomas; these are called Langhans giant cells. They consist of a large mass of cytoplasm and many nuclei.
- Granulomas associated with certain infectious organisms (classically *Mycobacterium tuberculosis*) often contain a central zone of necrosis.
  Grossly, this has a granular, cheesy appearance and is therefore called **caseous necrosis.**
  Microscopically, this necrotic material appears as amorphous (shapeless), structureless, eosinophilic, granular debris, with loss of cellular details.
- The granulomas in Crohn disease, sarcoidosis, and foreign body reactions tend to **not have necrotic centers** and are said to be *non-caseating*.
- Healing of granulomas is accompanied by fibrosis that may be extensive.

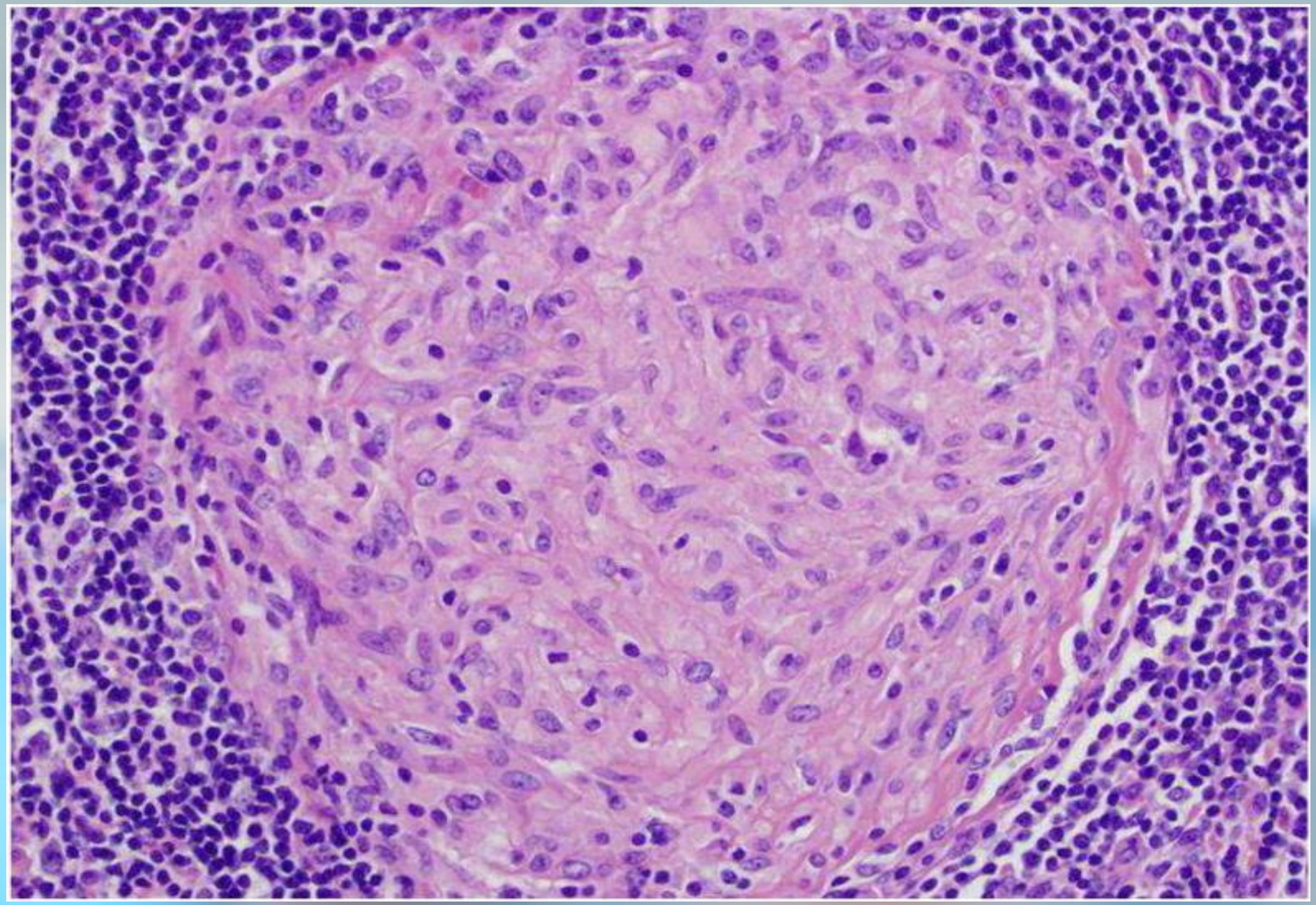
Chronic Specific inflammation: Caseating Granuloma





Typical tuberculous granuloma showing an area of central necrosis surrounded by multiple multinucleate giant cells, epithelioid cells, and lymphocytes.

Chronic Specific inflammation: Non-Caseating Granuloma

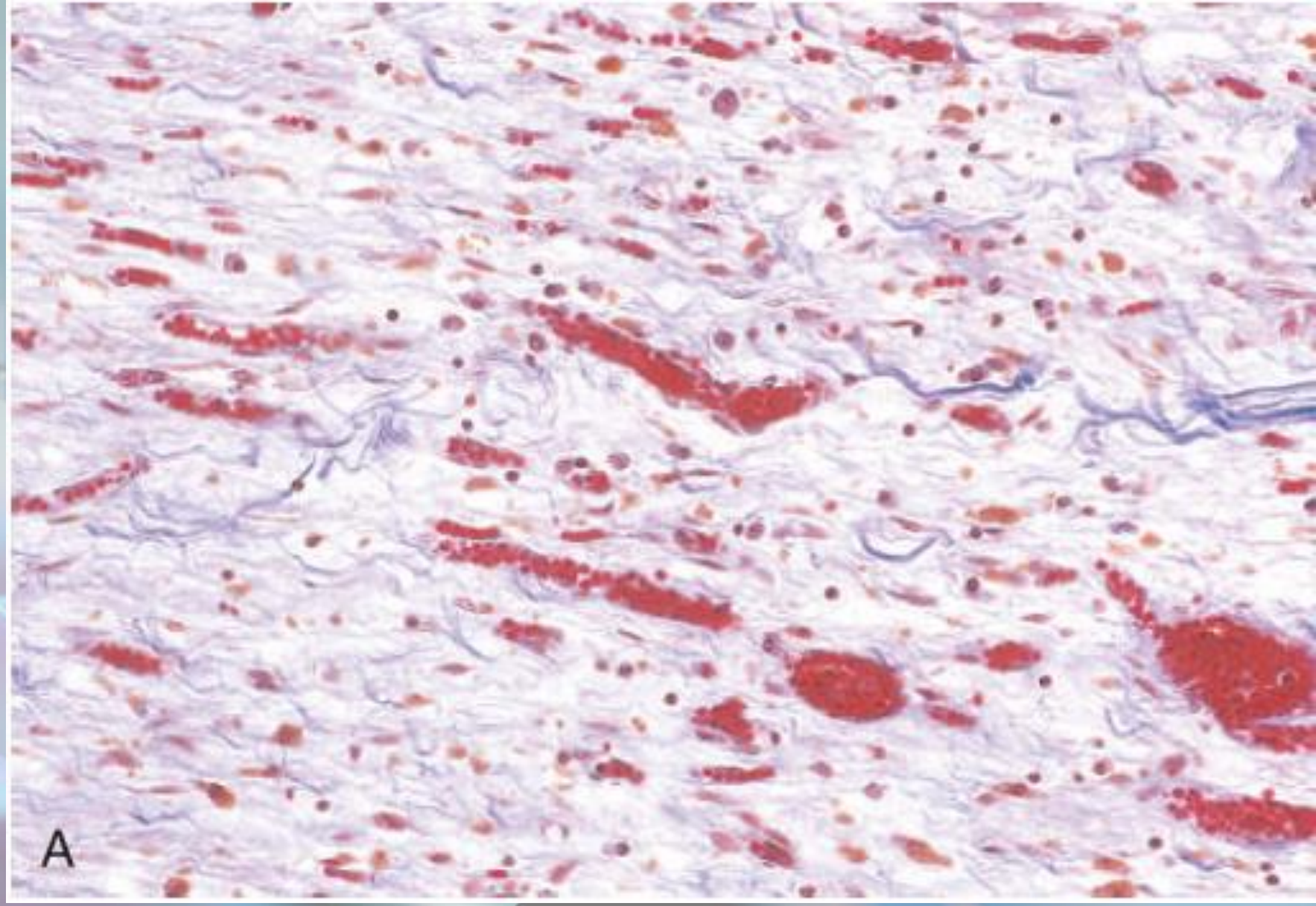


Chronic inflammation: tissue repair

❖**Early Tissue Repair:** **Granulation tissue** is characterized by proliferation of fibroblasts and new thin-walled, delicate capillaries in a loose extracellular matrix, often with admixed inflammatory cells, mainly macrophages.

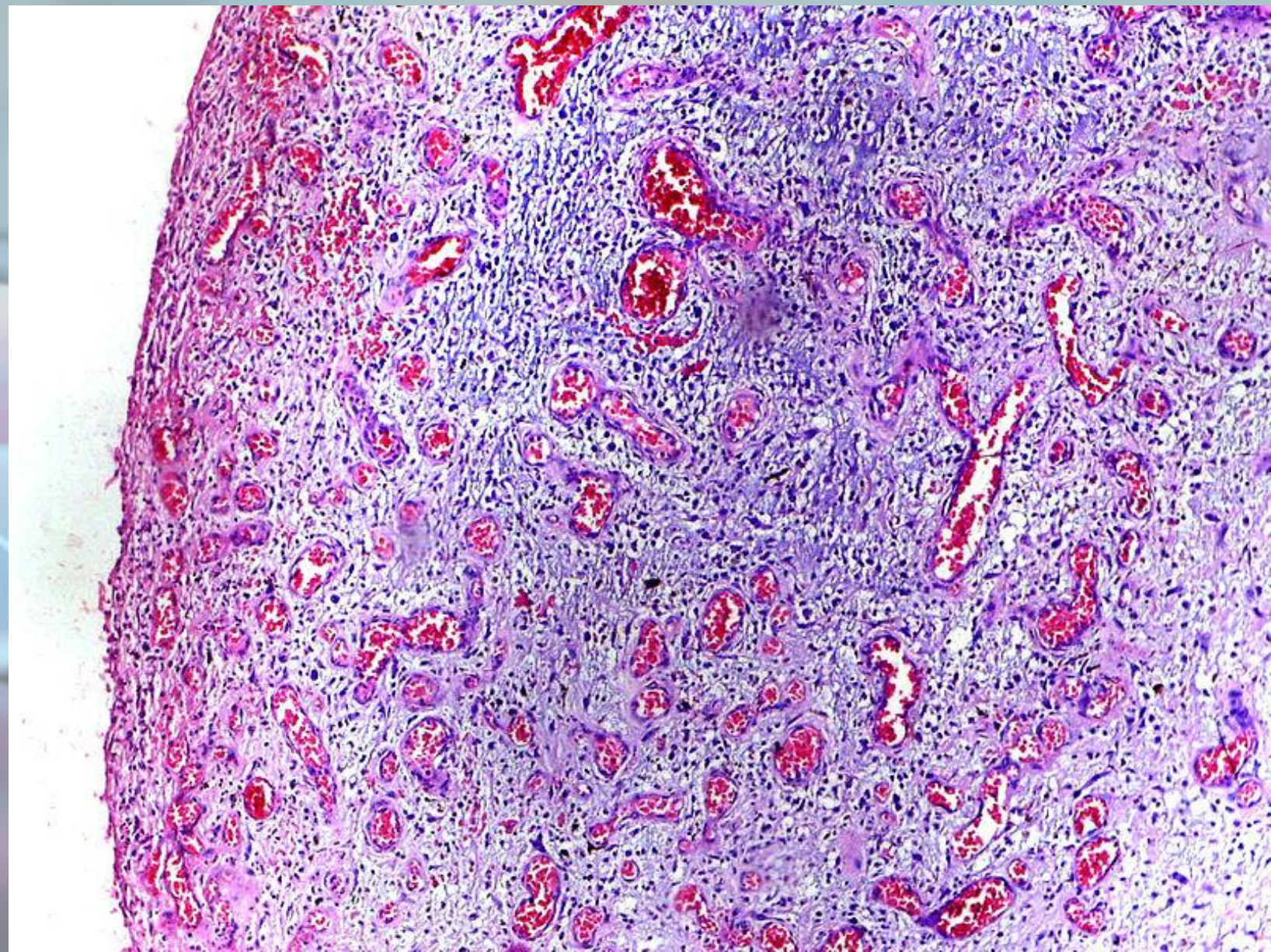
❖**Late Tissue Repair:** A **scar** or **fibrosis** in tissues is composed of largely inactive, spindle-shaped fibroblasts, dense collagen, fragments of elastic tissue, and other ECM components. Pathologists often use special stains to identify different protein constituents of scars and fibrotic tissues. The trichrome stain detects collagen fibers, and the elastin stain identifies delicate fibers of elastin, which is the major component of pliable elastic tissue.

Early Tissue Repair:
Granulation tissue



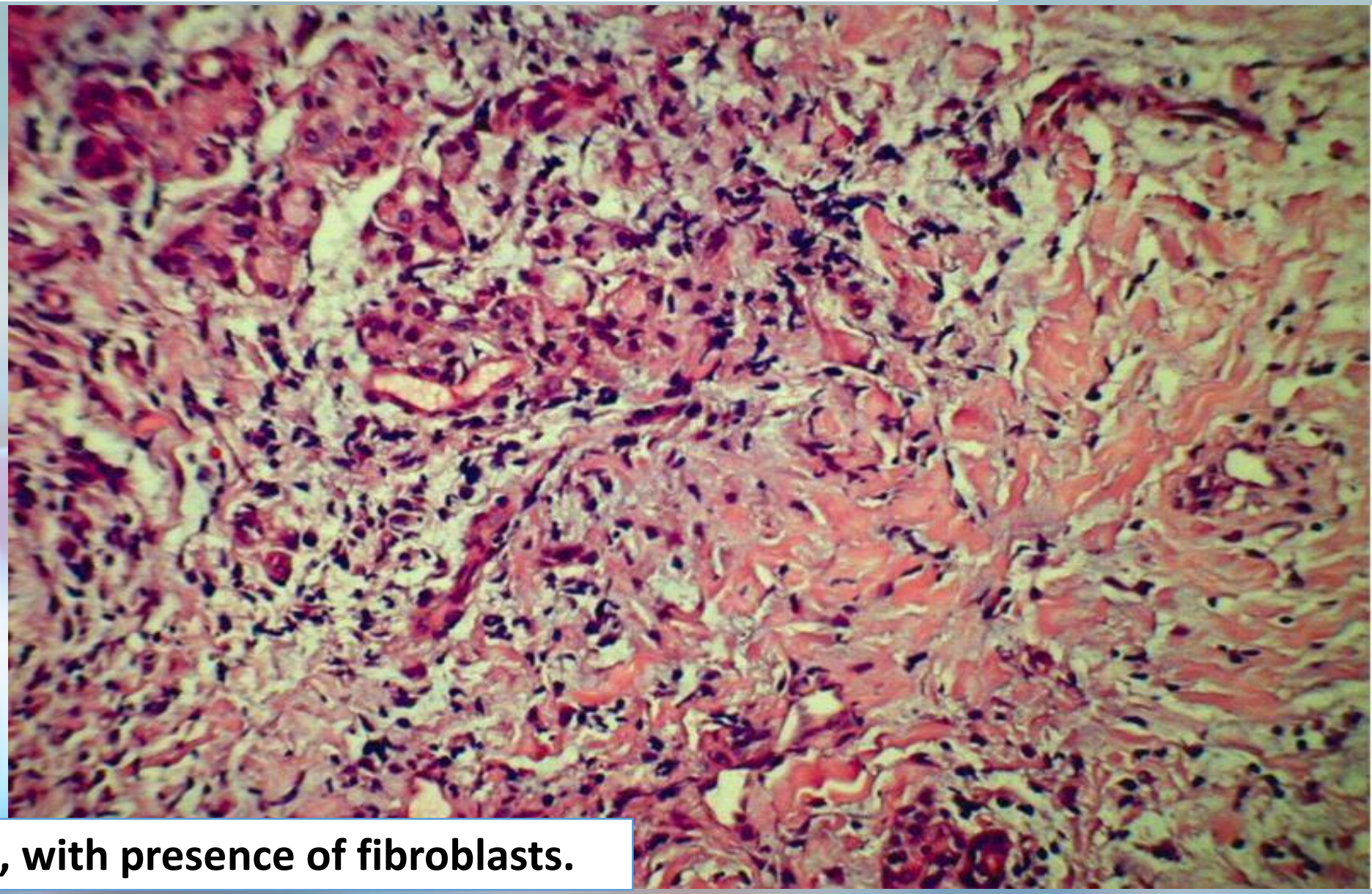
Granulation tissue showing numerous blood vessels, edema, and a loose extracellular matrix containing occasional inflammatory cells. Collagen is stained blue by the trichrome stain.

Chronic non-specific inflammation
Early tissue repair (granulation tissue formation)



Granulation tissue showing numerous proliferating capillaries.

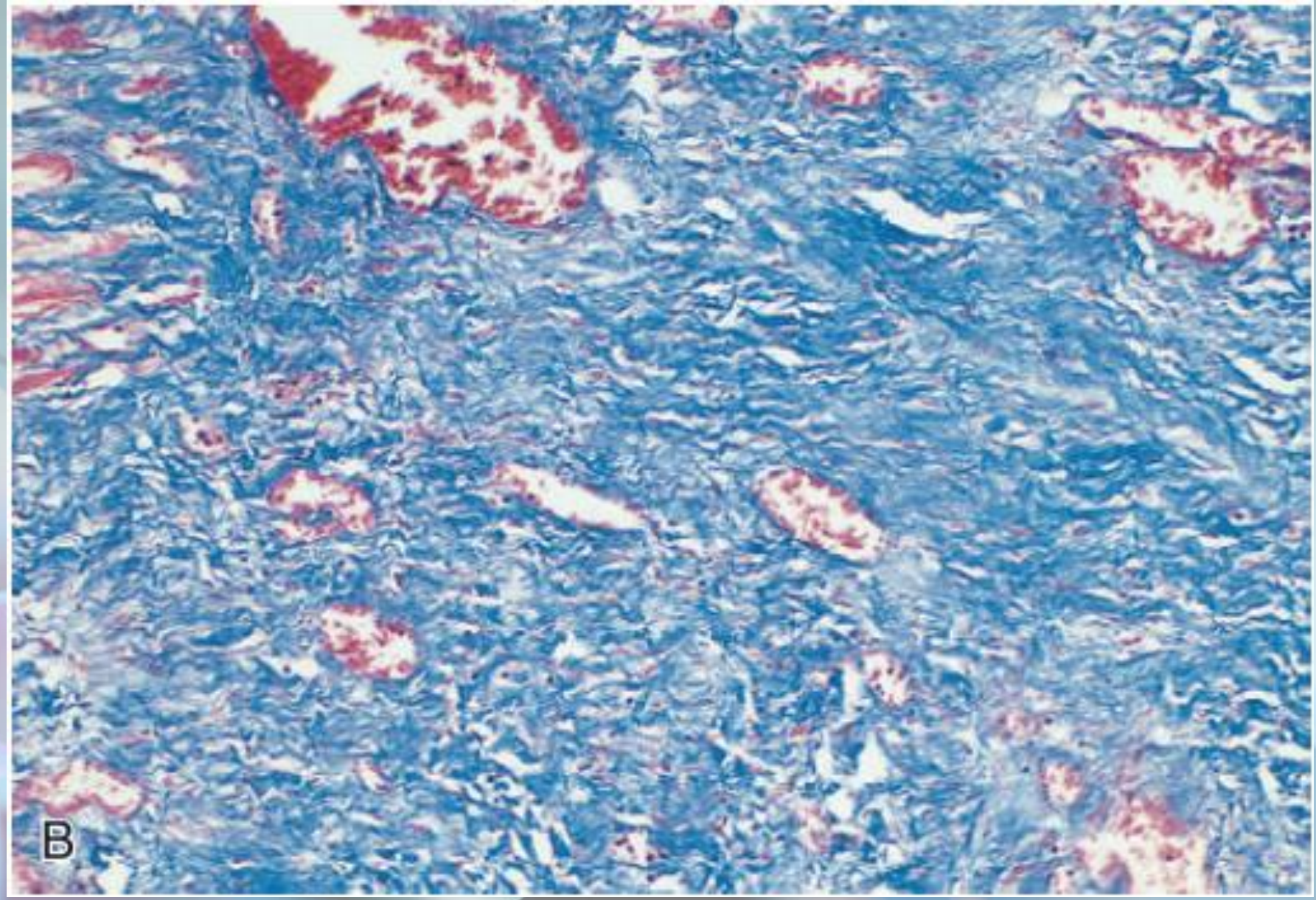
Chronic non-specific inflammation
Late tissue repair (Fibrous tissue formation)



Fibrous tissue formation, with presence of fibroblasts.

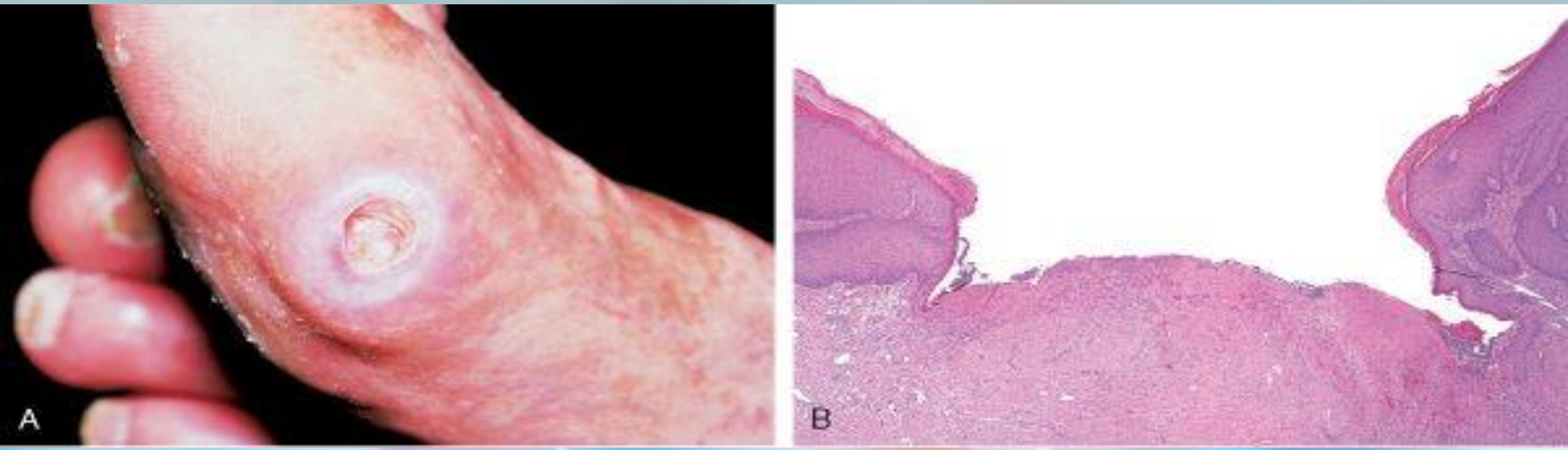
Late Tissue Repair:

A **Mature scar** or **fibrosis**



Trichrome stain of mature scar, showing dense collagen (stained blue) and scattered vascular channels.

Skin ulcer; with necrotic tissue.



Segmental loss of the epidermis, including the basement membrane, with exposure of the underlying dermis. The margins and base of the ulcer develop fibroblast proliferation, scarring, and the accumulation of lymphocytes, macrophages, and plasma cells.

Scar formation (Gross wound healing)

Characteristic Features:

lining of fibrous tissue

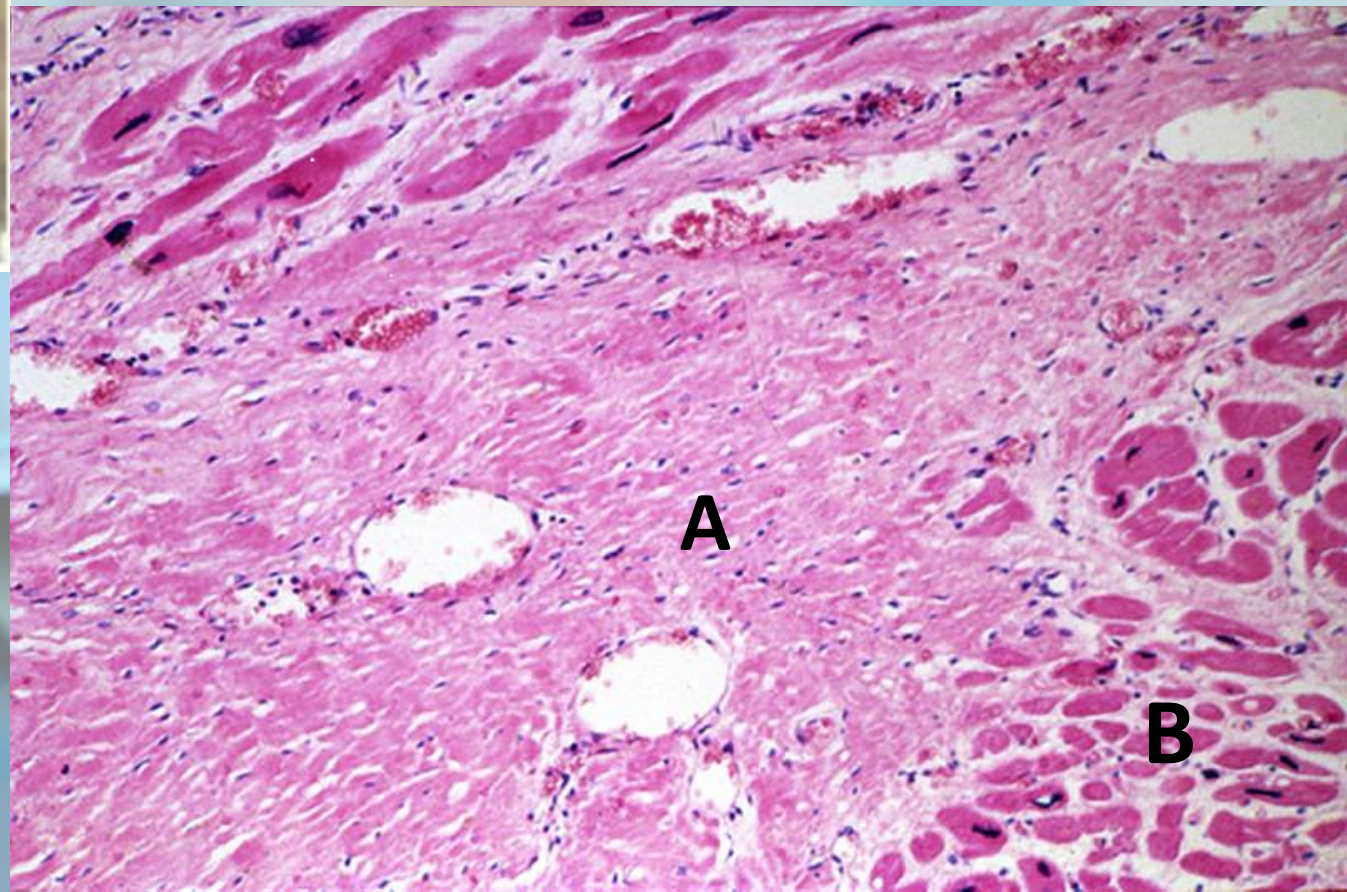
(due to collagen deposition)

Scar formation after MI:

Characteristic Features:

A: Fibrous tissue

B: Cardiac muscle cell

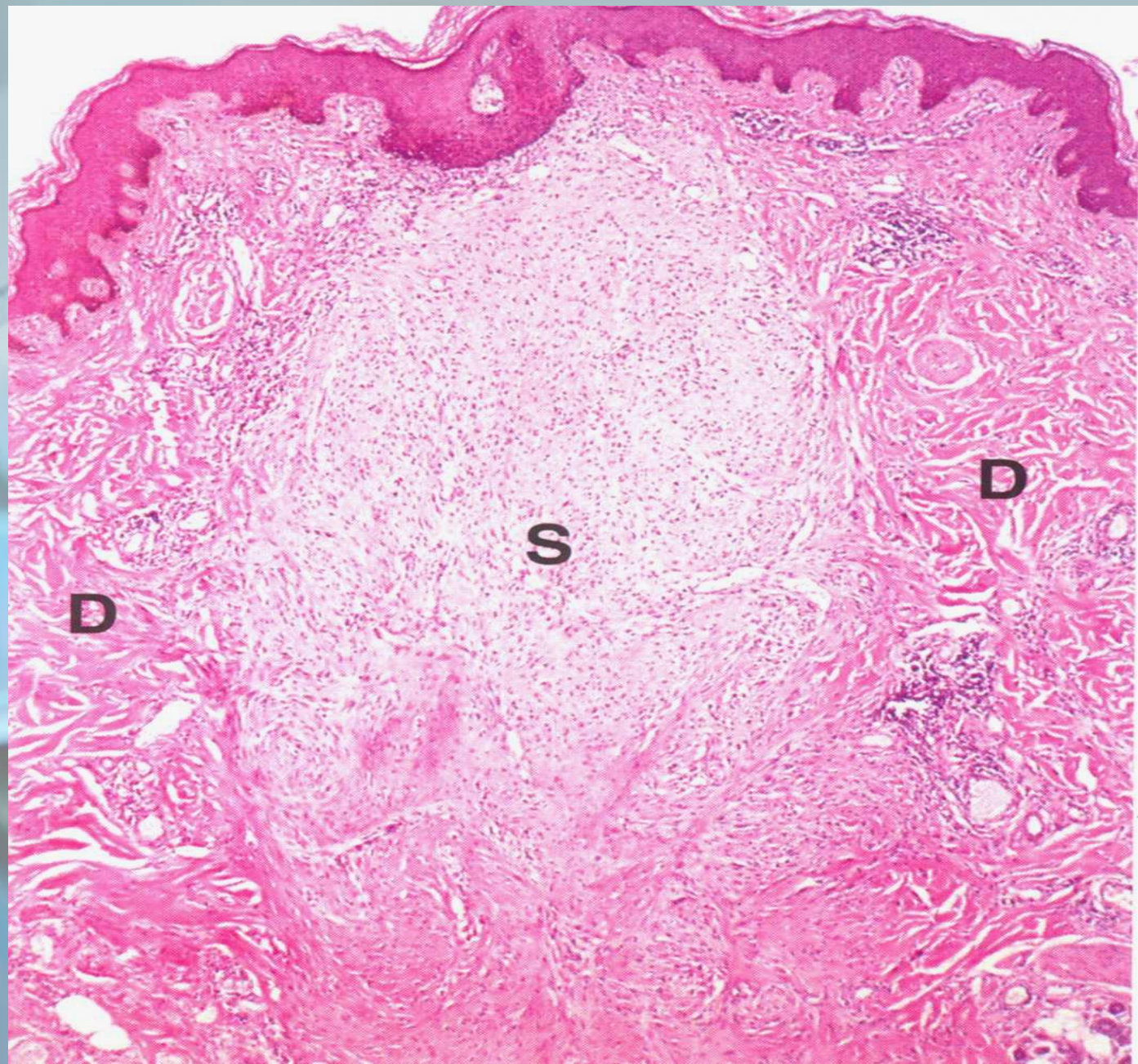


Keloid and Hypertrophic scar

Keloids:
are raised scars that grow *beyond* the borders of the original wound.
Develop in 15% to 20% of African Americans, Asians, and Hispanics, suggesting a genetic predisposition.
Often refractory to medical and surgical intervention.

Hypertrophic scars:
are raised scars that remain *within* the confines of the original wound.
Frequently regress spontaneously.

Keloid (scar)



Characteristic Features:

Grossly: Large Hypertrophic scar extending beyond the edge of the wound.

Microscopically: Excessive collagen bundle (pale in color)

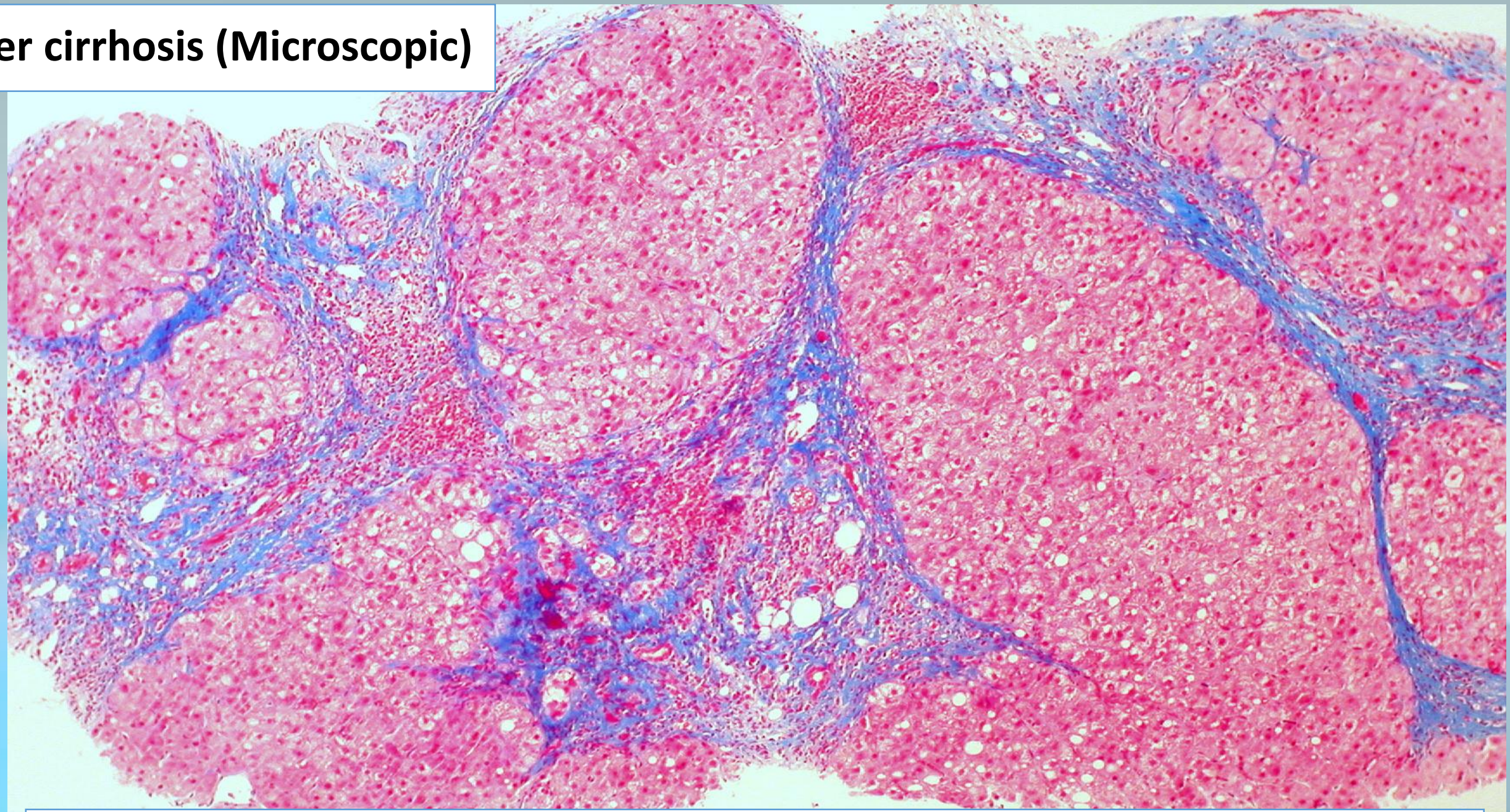
Contracture

Fibrous tissue formation >> loss of skin elasticity >> shortening >> deformity.

Liver cirrhosis

Presence of nodules (Micro or Macro)

Liver cirrhosis (Microscopic)



Fibrosis +regenerative nodule (loss of the normal architecture)

Thank you..